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PHYSICS ABSTRACTS

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Physics Abstracts

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PHYSICS ABSTRACTS

Volume 60 JULY 1957 Number 715

MATHEMATICS 51

517.3

5787. LINEAR-SYSTEM INTEGRAL TRANSFORM RELATIONS.
J.R.Macdonald and M.K.Brachman.
Rev. mod. Phys., Vol. 28, No. 4, 393-422 (Oct., 1956).

A mathematical paper developing the basic properties of integral transforms and the relations between distribution functions. It is an expository and review article with a long bibliography of papers, including many dealing with examples in physics where integral transforms are needed in discussing linear systems. Appendices deal with the various types of transforms, impulse function relations and the transformation of the Kronig–Kramers relations.
L.S.Goddard

517.9 : 534.131

5788. UNIFIED TREATMENT OF THE VIBRATING ARM.
D.McLachlan, Jr.
Amer. J. Phys., Vol. 25, No. 4, 228-40 (April, 1957).

This paper presents a method of solving certain differential equations of physics in a manner that aids the physics student to grasp the relationships between several of the functions with which he is already familiar. The method of making the relationships apparent is based on the use of one procedure for deriving the circular functions, hyperbolic functions, and elliptical functions as well as others that are less common. While the method herein presented has a certain amount of generality, it is restricted to various types of force functions and does not include friction, induction, or driving forces. The physical illustration is a single vibrating mass and no discussion is given of vibrating strings or membranes. A.

517.9 : 534.131

5789. UNIFIED TREATMENT OF THE VIBRATING ARM. II. THE SOLUTION WHEN THE RESTORING FORCE IS POSITIVE AND ALSO WHEN IT IS EXPRESSED AS A POWER SERIES IN Ψ.
D.McLachlan, Jr.
Amer. J. Phys., Vol. 25, No. 4, 241-8 (April, 1957).

Three main subjects are discussed: (a) nonperiodic systems; (b) the restoring force as a power series in Ψ; and (c) methods for testing the validity of a solution. The discussion leads to interesting and familiar subjects such as hyperbolic and elliptical functions.
A.

517.9 : 621.373.431.1

5790. METHODS OF "ANALYSIS SITUS" IN THE SOLUTION OF NON-LINEAR DIFFERENTIAL EQUATIONS.
P.Hontoy and P.Janssens.
Rev. H.F., Vol. 3, No. 6, 221-44 (1956). In French.

Explains the use of topological methods in the solution of non-linear equations. It is mainly devoted to singular points and their classification and stability. An attempt is made to analyse topologically the general equation $x'' + \omega^2 x = kf(x,x')$. L.S.Goddard

518.5

5791. PROGRAMME DESIGN FOR THE C.S.I.R.O. MARK I COMPUTER. IV. AUTOMATIC PROGRAMMING BY SIMPLE COMPILER TECHNIQUES. G.W.Hill and T.Pearcey.
Austral. J. Phys., Vol. 10, No. 1, 132-61 (March, 1957).

For Pt III see Abstr. 3 (1955). Techniques are described for using the C.S.I.R.O. Mark I computer to assemble complete programmes from greatly reduced input programmes by selecting and transferring routines from standard libraries and forming appropriate commands to interconnect routines and the problem programme. The "compiler" process is described for computer-code programmes, and for hyper-code programmes which use interpretive routines to provide elaborate arithmetical operations corresponding to each hyper-code. Examples of compiler routines are given in computer-code command form and as schematic outlines, and the compiler processes are illustrated by simple problem examples. Possible extensions of compiler techniques are considered and processes for using compiler techniques are discussed. Use of compiler techniques reduces considerably the "human error" in programmes, training time of programmers, and the time required for preparation, insertion, and checking of problem programmes. A.

519.241.1 : 518.5

5792. MEASUREMENT OF CORRELATION COEFFICIENTS.
S.H.Cameron.
J. appl. Phys., Vol. 28, No. 3, 377-8 (March, 1957).

The correlation measurement technique (Abstr. 6291/1956) is confirmed by experimental results which show the device accurate to 0.05. A more complicated, but ten times more accurate instrumentation is described. T.W.Olle

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.2 : 523.164

5793. A NEW FORM FOR A GIANT RADIO TELESCOPE.
A.K.Head.
Nature (London), Vol. 179, 692-3 (April 6, 1957).

To observe the 21 cm line of neutral hydrogen, a parabolic reflector must not deviate by more than one inch from its theoretical shape, which renders the construction of a large steerable paraboloid with the requisite tolerance a difficult task. It is suggested that a fixed hemispherical mirror combined with a smaller steerable barrel-shaped reflector could overcome this difficulty. A theoretical comparison with an equivalent paraboloid suggests that the gain and side-lobes are similar, and that both can operate over the same wavelength range, but operation with a displaced feed is impracticable. M.W.Ovenden

522.612

5794. A STUDY OF THE LYOT POLARIZING FILTERS FOR OBSERVING THE SOLAR CHROMOSPHERE CONSTRUCTED BY "LA SOCIÉTÉ OPTIQUE ET PRÉCISION DE LEVALLOIS".
A.Dollfus.
Rev. Opt., Vol. 35, No. 10, 539-49 (Oct., 1956). In French.

A full description is given of optical characteristics, allowed tolerances, and test data for the various component parts of Lyot monochromatic filters, together with details of their specification and performance. D.R.Barber

522.612

5795. POLARIZING FILTERS FOR OBSERVING THE SOLAR CORONA. A.Dollfus.
Rev. Opt., Vol. 35, No. 12, 625-40 (Dec., 1956). In French.

Two monochromatic filters composed of spar and glass polarizers, and compound quartz plates are described. They combine high overall transmission with a 6 degree field, and have equivalent widths from 1 to 3 A. D.R.Barber

523.11

5796. STAR FORMATION IN MAGNETIC DUST CLOUDS.
L. Mestel and L.Spitzer.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 5, 503-14 (1956).

The paper deals with the problem of gravitational condensation in the presence of a magnetic field. It is shown that as long as the field is frozen into the contracting cloud the magnetic pressure sets

a lower limit to the mass that can remain gravitationally bound: if the field is taken as 10^{-6} gauss in regions of density 10 H atoms/cm^3, this lower limit is $\cong 5 \times 10^2$ ⊙. However, if the bulk of the cloud is obscured from galactic starlight by dust grains, the plasma density within the cloud will decline rapidly, as ions and electrons attach themselves to the grains. When the plasma density is low enough the frictional coupling between plasma and neutral gas will be so small that the distorted magnetic field will be able to straighten itself, dragging the remains of the plasma with is, while the bulk of the cloud contracts across the field. With the magnetic energy so reduced to a small fraction of the gravitational energy, the cloud is able to break up into stars. A.

523.112

5797. MACH'S PRINCIPLE AND THE EXPANDING UNIVERSE. O.Costa de Beauregard.
J. Phys. Radium, Vol. 18, No. 1, 73-4 (Jan., 1957). In French.

Adopting Park's suggestion that the force on a particle is given as I times the mass-acceleration, it is shown that the coefficient I is proportional to the mean gravitational potential in the case of a static Einstein universe, and that I varies directly as the radius in the case of a Lemaître universe. The conservation of mass and energy in an expanding universe is briefly considered. R.A.Newing

523.16

5798. THE ACCELERATION OF THE CHARGED PARTICLES OF A MOVING MAGNETIZED MEDIUM.
A.A.Logunov and Ya.P.Terletskiĭ.
Vestnik Moskov.Univ., No. 3, 63-6 (1956). In Russian.

The paper is entirely theoretical. Probably today few physicists doubt the existence of an interstellar magnetic field although direct proof is lacking. If it is assumed that the field is created by turbulent motion of interstellar gas, then there are two possibilities relative to the state of the magnetic field of the Galaxy. Either the process of growth of the magnetic field on account of the kinetic energy of turbulent motion of the interstellar gas is continuing at the present time; or the process has already finished and at present only local fluctuational changes of the field occur in separate regions of the interstellar medium. In an earlier paper (Abstr. 5764/1954), the authors considered the acceleration of particles for the first case. The present paper examines the possibility for the second case. C.R.S.Manders

523.161

5799. A MORE ACCURATE DIFFUSION EQUATION FOR COSMIC PROTONS IN INTERSTELLAR MEDIUM. Ya.P.Terletskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 101, No. 1, 59-62 (1955). In Russian.

It is argued that the theories of Fermi (1948), and also of some Russian authors, are incomplete in so far as they assume that the cosmic protons lose all their energy as a result of collisions with protons of the interstellar gas. Assuming that the acceleration of the cosmic protons is due to turbulent motion of magnetized interstellar medium, a corrected diffusion equation is set up. This leads to an energy distribution $f(E)\,dE = E^{-\gamma}\,dE$ (cf. Fermi, 1948) in which $\gamma > \sim 2$, if it is assumed that $\alpha T \ll 1$ and that the fraction of energy lost in producing π-mesons in the proton–proton collisions tends to zero. S.Chomet

523.164.3

5800. RELATION OF 11-METRE SOLAR SYSTEM PHENOMENA TO SOLAR DISTURBANCES. J.D.Kraus.
Nature (London), Vol. 179, 371-2 (Feb. 16, 1957).

Observations on 11 metres show relationships between an eruptive solar prominence (10 February, 1956) and two solar flares (17 May and 31 August, 1956) with events involving Venus, the earth and the moon. In one case it appears that a stream of particles ejected by the sun encountered Venus (giving rise to radiation) and subsequently formed an ion cloud about the moon. On another occasion, evidence was obtained for an ion cloud 1°-2° in angular extent disposed asymmetrically with respect to the moon but moving with it. It is suggested that the properties of such an ion cloud may explain the anomalous delay-times for Venusian signals reflected by the moon (see Abstr. 1847/1957). M.W.Ovenden

523.164.3

5801. REFLEXION OF RADIO WAVES FROM THE MOON. F.J.Kerr and C.A.Shain; J.D.Kraus.
Nature (London), Vol. 179, 433 (Feb. 23, 1957).

Observation of radar echoes on 14 metres suggest that the moon's surface acts as an isotropic, non-absorbing rough scatterer, without any large areas of specular reflection. The suggestion by Kraus (Abstr. 1847/1957) of specular lunar reflection of signals of a supposed Venusian origin is therefore unlikely to be true. Kraus, in reply, refers to earlier work (see preceding abstract) for evidence of temporary lunar ion clouds, and suggests that they are the reflectors. M.W.Ovenden

523.164.32 : 551.510.535

A RELATION BETWEEN THE IONIZATION OF THE E-LAYER OF THE IONOSPHERE AND SOLAR RADIO RADIATION. See Abstr. 5756

523.164.4

5802. GALACTIC ABSORPTION OF 19.7 Mc/s RADIATION. C.A.Shain.
Austral. J. Phys., Vol. 10, No. 1, 195-203 (March, 1957).

Observations have been made of galactic radiation at a frequency of 19.7 Mc/s using an aerial having a beamwidth 1°.4. The effect of an absorbing band of H II regions around the galactic equator is clearly seen. Isolated H II regions, some very faint, have been detected in absorption. A detailed study of the sky near the galactic centre shows that the source Sagittarius-A is observed in absorption at 19.7 Mc/s. It is deduced, as a consequence of the small angular width of the equatorial absorbing band, that even at frequencies as high as 600 Mc/s thermal radiation contributes only a small fraction of the observed emission. A.

523.164.42

5803. A PRELIMINARY SURVEY OF RADIO SOURCES IN A LIMITED REGION OF THE SKY AT A WAVELENGTH OF 3.5 m. B.Y.Mills and O.B.Slee
Austral. J. Phys., Vol. 10, No. 1, 162-94 (March, 1957).

A preliminary catalogue has been prepared of radio-sources observed in a sample area of about one steradian near the celestial equator: a total of 383 sources is listed. The brightest nebulae in the area are found to be radio sources. Statistical analysis of the catalogue reveals no obvious cosmological effects except, perhaps, for a significant degree of clustering which may be indicative of metagalactic structure. The catalogue is compared in detail with a recent Cambridge catalogue which includes the sample area; it is found that they are almost completely discordant. A theory is developed which explains this discordance in terms of instrumental effects and it is concluded that a major part of the Cambridge catalogue is affected by the low resolution of their radio interferometer. A.

523.164.42 : 523.161

5804. RADIO STAR SCINTILLATIONS AND INTERSTELLAR HYDROGEN. G.A.Harrower.
Nature (London), Vol. 179, 608-10 (March 23, 1957).

From continuous observations made throughout 1954 of the time-variation in percentage occurrence of scintillation of radio-signals from the strong source in Cassiopeia, on a frequency of 50 Mc/s, it is concluded that the scintillation maxima found in February, August-September, and October-November are attributable either to the accretion of interstellar matter by the sun, or to particles (probably protons) emanating directly from the sun (August-September maxima). D.R.Barber

523.164.43 : 523.162

5805. INTENSITY OF THE RADIO LINE OF GALACTIC DEUTERIUM. R.L.Adgie and J.S.Hey.
Nature (London), Vol. 179, 370-1 (Feb. 16, 1957).

Observations with an improved receiver (details of which are given) show no significant deuterium absorption at 327 Mc/s, and set an upper limit of 0.1° K to the intensity of any absorption. The average abundance of deuterium does not exceed 1/2 000 that of hydrogen. M.W.Ovenden

523.164.85 : 523.53

5806. THE DISTRIBUTION OF THE ORBITS OF SPORADIC METEORS. A.A.Weiss.
Austral. J. Phys., Vol. 10, No. 1, 77-102 (March, 1957).

The directions of the reflection points of sporadic meteor trails for March and September 1953, and the hourly echo rates of sporadic meteors obtained from the Adelaide radio survey of meteor activity over 1952-1956 are analysed. Diurnal and annual variations in the sporadic echo rate are predicted from contemporary theory on the reflection of radiowaves from meteor trails for several model distributions. A sporadic distribution is derived which consists of a concentration of direct short-period orbits to the plane of the ecliptic superimposed upon a more uniform distribution of near-parabolic orbits. This distribution is consistent with the results of radar, visual, and telescopic surveys in the northern hemisphere. The density of sporadic meteors round the earth's orbit is also derived. A

523.5

5807. BOMBARDMENT OF THE EARTH BY METEORS.
Nature (London), Vol. 179, 121-4 (Jan. 19, 1957).

Report of a geophysical discussion held at the Royal Astronomical Society, London, on November 16, 1956. Among the topics discussed were: (i) the chemical analysis of meteorites (M.H.Hey); (ii) the building-up of the earth by meteoritic accretion, and the origin of the lunar surface features (T.Gold), and (iii) the number and mass distribution of meteors from radar observations (J.G.Davies). M.W.Ovenden

523.51 : 539.155.2

5808. ABUNDANCES OF METEORIC LEAD ISOTOPES.
R.D.Russell.
Nature (London), Vol. 179, 92 (Jan. 12, 1957).

The author compares the meteorite lead isotope ratios with the observed ratios in terrestial minerals, and suggests that the isotopic data of Patterson (Geochimica et Cosmochimica Acta, Vol. 10, 230, 1956) could be interpreted as indicating recent chemical alteration of some stone meteorites. H.C.Cole

523.53 : 551.577.37

EFFECTS OF METEOR SHOWERS ON ATMOSPHERIC PRECIPITATION. See Abstr. 5767

523.6 : 535.214.4

A NEW RADIOMETRIC EFFECT AND ITS APPLICATION TO COMETS. See Abstr. 5153

523.77

5809. A CONNEXION BETWEEN THE GRANULATION AND THE STRUCTURE OF THE LOW CHROMOSPHERE.
L.Goldberg, O.C.Mohler and J.D.Brown.
Nature (London), Vol. 179, 369-70 (Feb. 16, 1957).

Solar spectra taken with a vacuum spectrograph show a complex structure of the hydrogen line cores, where streaks of chromospheric origin are superimposed upon a diffuse photospheric contour. The weaker metallic lines show the zig-zag appearance caused by Doppler shifts associated with the granulation. It is noted that the chromospheric streaks for Hβ occur in conjunction with violet Doppler shifts for the Fe I line 4859.747 A. Although no pronounced correlation is observed between the radial velocities of the corresponding features in these two lines, it is noted that the streaks in the Hβ line are mostly violet-shifted, the velocity spread for the Hβ features being greater than that for the Fe I line. It is suggested that the Hβ features are produced by extensions of the granular columns into the low chromosphere. M.W.Ovenden

523.874

5810. RED-SHIFTS IN THE SPECTRA OF EXTRAGALACTIC NEBULAE. M.L.Humason.
"Vistas in Astronomy", Volume II, 1620-8. See Abstr. 10 (1957).

Red-shifts measured in some 600 extragalactic nebulae, obtained from spectra taken at the Mount Wilson and Palomar Observatories, are discussed. The dispersion ranged from 370-490 A/mm. The largest red-shift is +60920 km/sec;this nebula is of 19th magnitude. At this magnitude Hubble's red-shift law still appears to be linear, and red-shifts increase at the rate of 530 km/sec per million parsecs (measured on the so-called "old distance-scale"). It is seen that red-shifts cannot be distinguished from Doppler shifts; they are constant within any given spectrum within the errors of measurement. The largest red-shifts now approximate 1/5 of the velocity of light: if red-shifts are velocities, then measurements of line displacements should be reduced by use of the relativistic Doppler equation, and true velocities would become noticeably smaller than the values c. $d\lambda/\lambda$. A.Beer

523.877

5811. THE EMISSION OF CONTINUOUS RADIATION IN STELLAR ATMOSPHERES. B.E.J.Pagel.
Astrophys. J., Vol. 125, No. 1, 297-300 (Jan., 1957).

The conditions under which it is valid, from a microscopic viewpoint, to apply Kirchhoff's law to the continuous emission of radiation from stellar atmospheres are examined. Free-bound transitions which involve: (a) H, and (b) H^- are considered, as well as (c) free–free transitions. In each of these cases conditions for the equivalence to Kirchhoff's law are established. Effects of these conclusions upon the transfer equation are mentioned.

R.W.Nicholls

525.1 : 525.35

5812. SHIFTING OF THE EARTH'S AXIS OF ROTATION.
D.R.Inglis.
Rev. mod. Phys., Vol. 29, No. 1, 9-19 (Jan., 1957).

The terrestrial variation of the earth's axis of rotation includes two closely related phenomena, the Euler–Chandler nutation and the slow wandering of the pole. These are quite separate from the 27 000 year precession in space due to external torques which are here ignored. In Pt I an attempt is made to portray in simple terms the effect of the elastic deformation which takes place in the free nutation and is held responsible for the slowing down of the 306 day Euler nutation of a rigid earth to the observed Chandler period of about 420 days. A simplification is given of the Klein–Sommerfeld derivation of this old result of Hough which is based on assuming complete elastic readjustment to the instantaneous axis of rotation. For further elucidation a model is introduced which treats the axial and the equatorial regions as coupled gyroscopes. The model is modified to permit a viscous slipping of the elastic coupling, and in terms of this the damping of the nutation is discussed. In Pt II this model is further modified to facilitate discussion of the mechanism proposed by Gold to explain polar wandering, depending on static asymmetric deviations from a perfect figure of the earth, such as excess mountains in two opposite octants. On the basis of the rate of viscous readjustment as given by the damping of the nutation, it is shown that the possible asymmetries to be expected from the existence of continents in isostatic equilibrium are sufficient to give a rate of wandering much more rapid than needed to explain the long-term motion of the pole in geologic times, in keeping with Gold's suggestion that it may have taken place in a sequence of relatively short spurts from one temporarily stable position to another. The melting of circumpolar ice provides a feedback mechanism to stabilize the present position. Fermi suggested that the angular momentum of marine currents might be sufficient to explain the slow polar wandering. It is shown that this is indeed sufficient but a much less important contribution to the balance than the continental asymmetries. A.

525.24 : 537.591.1

5813. THE SOLAR COMPONENT OF THE COSMIC RADIATION AS PROBE OF THE EARTH'S MAGNETIC FIELD AT LARGE DISTANCES. G.Pfotzer.
Mitt. Max Planck-Inst. Phys. Stratosphäre, No. 9, 13 pp. (1956).
In German.

It is shown that the global intensity distribution of neutrons, registered during increases of the solar cosmic-ray component, can be used to examine the fit of the conventional geomagnetic coordinate system. The analysis of the neutron data taken during the afterphase of the increase on Feb. 23, 1956 has been interpreted to show that the data fit within the frame of the conventional system if one considers the eccentric position of the effective dipole. It is pointed out that a system which has been rotated to the West by 45° (Simpson et al., Abstr. 5995/1956) is compatible with the data only if there has been an anisotropy of the radiation during the afterphase. This is thought unlikely in view of the almost identical time dependence of the disturbance observed by all stations.

E.W.Kellermann

PHYSICS 53

53

5814. INTERNATIONAL CONGRESS ON THEORETICAL PHYSICS.
Rev. mod. Phys., Vol. 29, No. 2, 159-253 (April, 1957).

The principal papers presented at the Congress held at the University of Washington in Seattle, Washington, September 17-21, 1956, are published in full without the discussion. The titles are as follows: Relativity, V.Bargmann (161-74); Nuclear Physics, V.F.Weisskopf (174-81); Nuclear Shell Models, J.H.D.Jensen (182-5); Collective Motion in the Nucleus, B.R.Mottelson (186-90); Nuclear Reactions, A.M.Lane (191-9); Statistical Mechanics: A Survey of Recent Lines of Investigation, L.Van Hove (200-4); Superfluidity and Superconductivity, R.P.Feynman (205-14); Introductory Remarks on Meson Theory, H.Yukawa (213-15); Pi Mesodynamics, F.E.Low (216-22); Weak Interactions between "Old" Particles and Beta Decay, L.Michel (223-30); Present Knowledge about the New Particles, C.N.Yang (231-5); On the Origins of Cosmic Rays, P.Morrison (235-43); Stellar Energy Sources, E.E.Salpeter (244-53). Abstracts of the individual papers will be published later.

53

5815. CONFERENCE ON THE PHYSICS OF HIGH-ENERGY PARTICLES. E.M.Leĭkin, A.N.Burtsev, I.S.Danilkin, A.N.Lebedev and L.B.Okun'.
Uspekhi fiz. Nauk, Vol. 61, No. 1, 103-28 (1957). In Russian.

Report of the proceedings (Moscow, 14-22 May, 1956) with full account of the discussions. C.R.S.Manders

53.088

5816. CONSIDERATION OF SYSTEMATIC ERRORS FROM THE ERROR-PATTERN OF MEASUREMENTS. H.Weyerer.
Naturwissenschaften, Vol. 43, No. 21, 492 (1956). In German.

A series of observations may be analysed into a trend and a random component. It is suggested that the trend be estimated from the differences of the observed series. N.L.Johnson

FUNDAMENTALS 530.1

530.12

5817. ON THE USE OF A GRAVITATIONAL VECTOR POTENTIAL IN THE RELATIVITY THEORY OF BIRKHOFF. P.Kustaanheimo.
Ann Acad. Sci. Fennicae A I, No. 228, 23 pp. (1957).

It is shown that the infinite gravitational force caused by light rays in the original relativity theory of Birkhoff can be avoided if the theory is based on a vector potential instead of the tensor potential. The computation of the gravitational field is simplified by this change, because only four vector components instead of ten tensor components are to be computed by linear superposition. The equation of motion is slightly generalized by the change, there being now more arbitrary coefficients the values of which should be determined by comparison with observations. These coefficients can be so chosen that arbitrary numerical values are obtained for the three crucial tests. A.

530.12

5818. JUBILEE OF RELATIVITY THEORY [FÜNFZIG JAHRE RELATIVITÄTSTHEORIE].
Basle : Birkhauser Verlag (1956) 286 pp. [Helvetica Physica Acta Supplementum IV].

Proceedings of a Conference held in Berne, July, 1955. Abstracts of some of the papers will be published later.

530.12 : 531.18

5819. EXPERIMENTAL VERIFICATION OF THE "CLOCK-PARADOX" OF RELATIVITY. F.S.Crawford, Jr.
Nature (London), Vol. 179, 35-6 (Jan. 5, 1957).

It is suggested that relativistic time dilation and asymmetric ageing may be verified from observations already made of meson flux and decay rates at high and low altitudes. R.A.Newing

530.12 : 531.51

5820. THE GENERAL THEORY OF RELATIVITY AND NEWTON'S LAW OF GRAVITATION. C.Gilbert.
Nature (London), Vol. 179, 270 (Feb. 2, 1957).

It is suggested that the Newtonian coefficient γ may be regarded as a universal constant, or as inversely proportional to the epoch, according as Newtonian distance is defined in terms of "cosmic" coordinates, or in terms of a new "atomic" distance. R.A.Newing

530.12 : 537.212

5821. ELECTROSTATIC FIELDS IN [JORDAN'S] EXTENDED THEORY OF GRAVITATION. J.Ehlers.
Z. Phys., Vol. 146, No. 4, 515-26 (1956). In German.

The space–time metric is taken to be $ds^2 = \{\kappa^3 g(\Phi)\}^{-1} dl^2 - \kappa g(\Phi) dt^2$, where Φ is the electrostatic potential, the coefficient of gravitation κ being here a field variable. The quantity $g(\Phi)$ is shown to be of the form $\beta\Phi^2 + A\Phi + B$. An analogue of the Reissner–Nordström solution is obtained for static spherically symmetric fields. R.A.Newing

530.12

5822. VIOLATION OF PARITY CONSERVATION AND GENERAL RELATIVITY. E.C.G.Stueckelberg.
Phys. Rev., Vol. 106, No. 2, 388 (April 15, 1957).

The question has recently been raised, whether there can be a cosmological distinction between right and left. It is here pointed out that a cosmological asymmetry is perfectly compatible with the Riemannian space time of ordinary general relativity. P.M.Davidson

530.145

5823. PARITY NONCONSERVATION AND THE THEORY OF THE NEUTRINO. J.A.McLennan, Jr.
Phys. Rev., Vol. 106, No. 4, 821-2 (May 15, 1957).

The two-component neutrino theory of Lee and Yang and of Landau is discussed. It is shown that, for the free neutrino, their equations are equivalent to the Majorana equations, and thus are invariant under the full Lorentz group. A

530.145

5824. INVARIANCE REQUIREMENTS AND CONSERVATION LAWS. R.H.Penfield and H.Zatzkis.
Acta phys. Austriaca, Vol. 10, No. 3, 261-6 (1956).

The fact that invariance requirements lead to conservation laws regardless of whether the field equations are satisfied or not is brought out in this paper using gauge invariant theories as an example. As a consequence of the invariance requirements of the Lagrangian formulation, the resulting Euler–Lagrange equations do not allow a unique determination of the field variables as functions of their arguments even through boundary and initial conditions are prescribed. It is shown that this lack of uniqueness carries over to the Hamiltonian formalism with the result that the Hamiltonian itself is not unique. Choosing a particular Hamiltonian destroys the covariance and corresponds in electromagnetic theory to the adoption of the familiar gauge condition $\mathrm{div}\, A + (\partial\Phi/\partial t)/c = 0$. A

530.145

5825. CONSERVATION AND INVARIANCE. H.G.Schöpf.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 278-87 (1956). In German.

Deals with the well known connection between conservation laws and invariance under a group of transformations. W.A.Hepner

530.14

5826. THE INFRA-RED AND THE BLOCH–NORDSIECK DIVERGENCES. R.Ascoli.
Nature (London), Vol. 179, 727-8 (April 6, 1957).

It is suggested that these divergences are the consequence of too rough a schematization of reality. P.M.Davidson

530.14

5827. SUPPLEMENTARY BOSON-FIELD METHOD AND COLLECTIVE OSCILLATIONS. Z.Galasiewicz.
Acta phys. Polon., Vol. 15, No. 5, 295-303 (1956).

In this paper, the method of second quantization is investigated for an ensemble of interacting fermions described by the quantized wave function ψ. The work here is based on the supplementary variables method (D.Zubarev, Candidate's Degree Dissertation, Moscow University, Moscow, 1953; Bohm and Pines, Abstr. 1278/19 A supplementary boson field has been introduced into the theory in such a way that the quanta of this field describe the collective moti of an ensemble of fermions (electrons). This is possible, after sui able transformations, since operators connected with the suppleme ary boson field appear in the Hamiltonian. It is further shown that transformation of the Hamiltonian can be regarded as a transition new fermion operators formed from the old fermion operators and from boson operators associated with the supplementary boson fie The method presented here is compared with the method given in the paper of Tomonaga (Abstr. 3324/1951).

530.145

5828. SYMMETRY IN TIME AND TANIKAWA'S METHOD OF SUPERQUANTIZATION IN REGARD TO NEGATIVE ENERGY FIELDS. S.Watanabe.
Progr. theor. Phys., Vol. 15, No. 6, 523-35 (June, 1956).

It is shown (1) that the Dirac equation of electron fits exactly in the pattern of theory required by the method of double inferential state-vector (D.I.V. method) which was introduced to establish a perfect symmetry in time and (2) that application of the D.I.V. method to fields leads to a third quantization similar to the formalism proposed by Tanikawa. This paper is intended to shed further light on the relationship between the electric charge and the two directions of time, and to suggest a consistent method of handling negative energy fields. A new concept of "supercharge" is introduced. A.

530.145

5829. IMPROVEMENT OF QUANTUM ELECTRODYNAMICS PERTURBATION THEORY WITH HELP OF THE RENORMALIZATION GROUP. V.Z.Blank and D.V.Shirkov.
Nuclear Physics, Vol. 2, No. 4, 356-70 (Dec., 1956).

It is shown that the renormalization group technique previously used to improve perturbation theory formulae for the Green functions can also be effectively used to improve the vertex part formulae. A survey of results for Green functions is also presented. A.

530.145

5830. TWO LIMITING MOMENTA IN SCALAR ELECTRODYNAMICS. L.P.Gor'kov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 359-62 (1957). In Russian.

The possibility of introduction of two limiting momenta in scalar electrodynamics is investigated. It is shown that the difficulties connected with vanishing of the unnormalized charge also exist in the theory under consideration in the limiting case of point interaction. A.

530.145

5831. A NEW FORMULATION ON THE ELECTROMAGNETIC FIELD. T.Ohmura.
Progr. theor. Phys., Vol. 16, No. 6, 684-5 (Dec., 1956).

As a first step in discussing the structure of the electron, a new formulation of the electromagnetic field is given.

P.M.Davidson

530.145

5832. STABILITY OF THE ELECTRON. T.Ohmura.
Progr. theor. Phys., Vol. 16, No. 6, 685-6 (Dec., 1956).

It is shown that the scalar fields introduced earlier (see preceding abstract) can be considered as the "cohesive field".

W.A.Hepner

530.145

5833. OUT AND IN-GOING WAVES IN FINAL STATES. H.Olsen.
K. Norske Vidensk. Selsk. Forhandl., Vol. 28, No. 1, 10-15 (1955).

It is shown, by explicit calculation for non-relativistic particles without and with spin, that the spectral and angular distribution of the radiation in problems like bremsstrahlung is independent of the particular choice of the wave-function in the final state. The relation to space and time inversion (Abstr. 2075/1952) is discussed.

W.A.Hepner

530.145

5834. THE INTERACTION LAGRANGIAN FOR FUNDAMENTAL PARTICLES. A.Salam.
Nuclear Physics, Vol. 2, No. 2, 173-6 (Oct., 1956).

On the basis of d'Espagnat and Prentki's classification, the interaction Lagrangian is written down for all strong reactions of fundamental particles. Use is made of the invariance requirement for particle–antiparticle conjugation. A.

530.145

5835. RADIALLY SYMMETRIC SOLUTIONS OF BETHE–SALPETER EQUATION. S.N.Biswas and H.S.Green.
Nuclear Physics, Vol. 2, No. 2, 177-87 (Oct., 1956).

New exact solutions are obtained of the Bethe–Salpeter equation for a pair of fermions, in the ladder approximation and for zero boson mass. The solutions are applicable for small but non-vanishing total energy, and for scalar or pseudoscalar boson fields with ordinary or derivate coupling. A boundary condition, similar to that applied to the Schrödinger equation in three dimensions, is proposed, which reduces the continuum of eigenvalues for the coupling constant to a set of discrete values, except in the case of s(s) coupling. It is pointed out that this boundary condition also implies the existence of a new quantum number, with properties similar to those of the "strangeness" number already used to classify the new particles. A.

530.145

5836. CONTACT AND CORE INTERACTIONS ACCORDING TO DIRAC'S RELATIVISTIC THEORY OF THE ELECTRON. S.T.Ma.
Nuclear Physics, Vol. 2, No. 4, 347-55 (Dec., 1956).

Deals with the interactions between a Dirac electron and an atomic nucleus. It is shown that improvement of a well known approximate two-component form of the Dirac equation changes the repulsive contact interaction into a core interaction. The role played by the exact form of the core interaction in the determination of stationary states is analysed and compared with that of the hard core in the meson theory of nuclear forces. A.

530.145

5837. THEORY OF REARRANGEMENT COLLISIONS. S.T.Epstein.
Phys. Rev., Vol. 106, No. 3, 598 (May 1, 1957).

It is shown that if one omits a certain small term which appears in one of the integral equations describing rearrangement collisions, then that equation becomes inconsistent with the others. This result is of interest because the presence or absence of this term represents the essential formal difference between several recent theories of rearrangement collisions. A.

530.145

5838. THE RANGE OF THE INTERACTION BETWEEN DIFFERENT FERMIONS. M.Konuma.
Progr. theor. Phys., Vol. 16, No. 4, 259-64 (Oct., 1956).

The range of a vitual boson field coming from the transition between two fermions whose masses are different from each other is studied. The spread of a boson emitted by a heavier fermion is longer than that of the one emitted by a lighter fermion. The range of the exchange force potential between two fermions of different masses is longer than the Compton wavelength of the boson. The effects of this range-shift on the interaction between hyperons and heavy mesons are considered. A.

530.145 : 537.13 : 539.185

5839. ON THE EFFECTS OF HEAVY UNSTABLE PARTICLES TO THE ANOMALOUS MAGNETIC MOMENTS OF NUCLEONS. C.Iso and S.Iwao.
Progr. theor. Phys., Vol. 16, No. 4, 417-20 (Oct., 1956).

The authors calculate corrections to the magnetic moments of proton and neutron due to interactions with the hyperon and heavy-meson fields, assuming the latter have spins $\frac{1}{2}$ and 0, respectively. The results are given for each of the four possible combinations of even and odd parity for the two types of particle. J.W.G.Wignall

530.145

5840. NON-LOCAL AND NON-LINEAR FIELD THEORIES. D.I.Blokhintsev.
Uspekhi fiz. Nauk, Vol. 61, No. 2, 137-59 (1957). In Russian.

Following the considerable successes of renormalization theory and subsequent disappointments the author makes a critical examination of nonlocal and nonlinear field theory and of the physics of a strong interaction. 35 refs. (16 Soviet). C.R.S.Manders

530.145

5841. INTERMEDIATE-COUPLING INTERACTION OF A NON-RELATIVISTIC PARTICLE WITH A SCALAR FIELD. III. G.Höhler.
Z. Phys., Vol. 146, No. 5, 571-88 (1956). In German.

For Pt II see Abstr. 1883 (1957). The functions introduced under the variational postulate of Pt I (Abstr. 4371/1955) are expanded in spherical harmonics. As a simple special case, Lee and Pines' assumption is discussed. Its failure in the strong-coupling case is shown to be due mainly to the absence of s-p correlations. This can also be seen by comparison with the spherical harmonic expansion of the linear combinations discussed in Pt II. The approximation recently introduced by Gross represents a generalization of the Lee–Pines approximation, as can be seen by introducing operators which generate spherical waves instead of plane waves. The restriction to s-, p- and d-waves gives a good approximation both for weak and strong coupling, and should therefore suffice for the case of intermediate coupling. T.P.Brody

530.145

5842. BREMSSTRAHLUNG FROM NEUTRAL VECTOR PARTICLES WITH AN ANOMALOUS MAGNETIC MOMENT. K.Baumann.
Acta phys. Austriaca, Vol. 11, No. 1, 59-69 (1957). In German.

The cross-section for ionization and emission of one and two photons by a neutral vector particle with energy in the extreme relativistic region is calculated. The particle is assumed to be in a Coulomb field, and the momentum transfer of the field is cut off to take into account the finite extent of the source. The cross-section

for emission of one photon is proportional to the first power of the incident energy, that for two photons is proportional to the third power. The ionization cross-section reduces to the formula of Corben and Schwinger derived for high energies. It is indicated that such a particle might be responsible for the "Schein events". G.E.Brown

530.145

5843. THE STATES OF SPIN OF TENSOR FIELDS AND COMPARISON WITH THOSE OF FIELDS OF MAXIMUM INTEGRAL SPIN IN THE THEORY OF FUSION. K.-H.Tzou.
C.R. Acad. Sci. (Paris), Vol. 244, No. 14, 1886-8 (April 1, 1957). In French.

The composition of tensor fields with regard to the states of spin is analysed by general consideration based on the Clebsch–Gordon theorem. It is demonstrated that a tensor field of order n has the same spin composition as the field of spin of maximum integral n in the theory of fusion. A.

530.145

5844. DETAILED COMPARISON OF TENSOR FIELDS WITH FIELDS OF MAXIMUM INTEGRAL SPIN IN CONNECTION WITH THEIR COMPOSITION. K.-H.Tzou.
C.R. Acad. Sci. (Paris), Vol. 244, No. 15, 2009-11 (April 8, 1957). In French.

See preceding abstract.

530.145

5845. SYMMETRIC FORM OF THE NUCLEON EQUATION. R.Zaĭkov.
C.R. Acad. Bulg. Sci., Vol. 9, No. 3, 13-16 (July-Sept., 1956). In German.

The equation of the nucleon, in interaction with the electromagnetic field, the pion field, and a possible vector meson field, is written in terms of a seven-dimensional space (four space-time and three isotopic) with an eight-component spinor representing the nucleon. Expectation values of the various operators involved are interpreted. J.W.G.Wignall

530.145

5846. ON THE GREEN FUNCTION OF THE NEUTRON KINETIC EQUATION. Kh.Ya.Khristov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 5, 981-4 (1956). In Russian.

The Green function is expanded as a sum of product-integrals plus a delta-function term. This leads to a suitable trial function for the iteration; see Abstr. 5056 (1957). J.W.Gardner

530.145

5847. MAGNETIC MOMENTS OF THE NUCLEONS. S.K.Kundu.
Indian J. Phys., Vol. 30, No. 9, 450-4 (Sept., 1956).

It is shown how the magnetic moment of the neutron varies with cut-off limit of the momentum of the meson which the neutron emits and reabsorbs. Moreover, the influence of the magnetic field on the proton is included in the energy denominator of the perturbation matrix elements. A.

530.145

5848. ISOBARIC SPIN AND DESCRIPTION OF ANTIPARTICLES. V.Votruba.
Nuclear Physics, Vol. 2, No. 1, 98-108 (Sept., 1956).

Some remarks on the d'Espagnat–Prentki interpretation of the Gell-Mann model are made in connection with a symmetrical description of particles and antiparticles by means of quantized fields and antifields. A.

530.145

5849. ON THE ISOCOVARIANCE PROPERTIES OF LEPTONS. P.Román.
Nuclear Physics, Vol. 2, No. 6, 651-9 (Feb., 1957).

On the basis of a simple postulate regarding the weak interactions of baryons and leptons the transformation character of leptons in isobaric space is determined and various selection rules are studied. The slow decay of strange particles is also considered. A.

530.145

5850. COMMUTATION RELATIONS OF INTERACTING SPINOR FIELDS. R.Spitzer.
Phys. Rev., Vol. 105, No. 6, 1919-23 (March 15, 1957).

It is shown that the requirement that the Hamiltonian density commute with itself on a spacelike surface precludes the possibility that three or more different spinor fields, coupled to one another in Yukawa-type interactions, commute with each other. If the Hamiltonian contains only two such fields, however, they may be assumed either to commute or to anticommute without violating this requirement. A.

530.145

5851. DIRAC PARTICLES IN ARBITRARY EXTERNAL ELECTROMAGNETIC FIELDS. K.M.Case.
Phys. Rev., Vol. 106, No. 1, 173 (April 1, 1957).

The Dirac equation is used to discuss possible depolarization of particles with spin $\frac{1}{2}$ and gyromagnetic ratio 2 in pure electric, pure magnetic, and mixed electric and magnetic fields, without making non-relativistic approximations. In certain cases the particles are not depolarized; in these cases any depolarization occurring would provide a sensitive test of departures from the Dirac magnetic moment. J.W.G.Wignall

530.145

5852. SOME CONSEQUENCES OF TCP INVARIANCE. G.Lüders and B.Zumino.
Phys. Rev., Vol. 106, No. 2, 385 (April 15, 1957).

Invariance with respect to the product TCP, (T = time reversal, C = charge conjugation, P = parity) follows from invariance with respect to the proper Lorentz group alone. The authors examine which connections between properties of particles and antiparticles follow from this general invariance and which can only be deduced from more severe invariance requirements. P.M.Davidson

530.145

5853. RELATION OF ISOTOPIC SPIN SPACE TO SPACE-TIME. R.L.Ingraham.
Phys. Rev., Vol. 106, No. 3, 595-7 (May 1, 1957).

The customary form of physical space as the direct product of space-time and isotopic spin space can be replaced by a certain fusion of these two spaces into one space if one widens the group from the Lorentz group to the conformal space-time group which endows particles with an intrinsic finite size. It is shown that the familiar space-time transformations continue to induce their familiar Dirac spinor transformations, while the new space-time transformations in general induce isotopic spin transformations as well. The detailed correspondence is worked out for a theory of T = 1 bosons coupled to T= $\frac{1}{2}$ fermions. A.

530.145

5854. A RELATIVISTIC WAVE EQUATION FOR A PARTICLE WITH TWO MASS STATES OF SPIN 1 AND 0. H.Shimazu.
Progr. theor. Phys., Vol. 16, No. 4, 287-98 (Oct., 1956).

A relativistic wave-equation is given which describes a particle having two different mass-states of spin 1 and 0. The energy density is positive definite and the usual method of quantization is applicable. A.

530.145

5855. CHARGE INDEPENDENCE HYPOTHESIS AND LEPTONS. T.Ouchi and K.Senba.
Progr. theor. Phys., Vol. 16, No. 5, 528-30 (Nov., 1956).

A tentative scheme for leptons on the basis of the Pais–Nishijima–Gell-Mann theory is presented. W.A.Hepner

530.145

5856. SPECIAL THEORY OF RELATIVITY AND THE STRUCTURE OF ELEMENTARY PARTICLES. H.Yukawa.
Progr. theor. Phys., Vol. 16, No. 6, 688-90 (Dec., 1956).

Using non-local (product) fields, it is suggested that the external and internal parts of the Lagrangian of weak (as distinct from strong) interactions need not necessarily be invariant separately. A particular scheme is presented in which the internal spin corresponds to half the strangeness quantum number of Gell-Mann and Nishijima. W.A.Hepner

530.14

5857. ELECTROMAGNETIC STRUCTURE OF NUCLEONS. D.R.Yennie, M.M.Lévy and D.G.Ravenhall.
Rev. mod. Phys., Vol. 29, No. 1, 144-57 (Jan., 1957).

The theoretical implications of various experiments relating to the electromagnetic structure of nucleons are examined in the light of current field theory. It is concluded either that the nucleon core is about three times as large as would be expected from intuitive considerations of meson theory, or that there is some inconsistency in the present field theory. A

530.145 : 539.18 : 539.15

SHIFT OF LEVELS OF μ-MESONIC HYDROGEN AND STRUCTURE OF THE PROTON. See Abstr. 5571

530.14

5858. THE WKB METHOD FOR A COMPLEX POTENTIAL. C.B.O.Mohr.
Austral.J. Phys., Vol. 10, No. 1, 110-17 (March, 1957).

The extension of a complex potential, as used in the optical model of the nucleus, of the WKB method for the determination of

phase shifts in collision problems is discussed. The formula for the complex phase shifts is formally deduced, and its accuracy tested against exact calculations for a square potential well and a well with sloping sides. At low energies there occur large discrepancies; the WKB phases vary regularly with energy, whereas the exact values oscillate violently about the WKB values in a characteristic way and marked resonances occur. The factors affecting the accuracy of the method are discussed. At higher energies the fluctuation of the phases about the WKB value is less marked, and its effect largely cancels out as the result of a larger number of phases being involved in the scattering. A.

530.145

5859. ON THE COMPOUND STATE FORMED IN THE SCATTERING OF ELEMENTARY PARTICLES. M.S.Livshits.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 4, 799-802 (1956). In Russian.

The quantities in a dispersion formalism developed earlier (Abstr. 3961/1957) are evaluated for the case of the scattering of a photon by an electron, the electron first absorbing the photon. G.E.Brown

530.145

5860. PRINCIPLE OF INVARIANCE FOR HOMOGENEOUS MEDIUM OF ARBITRARY GEOMETRIC FORM. B.B.Kadomtsev.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 5, 831-4 (1957). In Russian.

Investigates the scattering laws under Lorentz, and related transformation groups. Both point and finite scatterers are considered, the latter being represented by some arbitrary geometric form-function, which may indeed include the point (delta-function) as a special case. Invariance is established for arbitrary form-functions and homogeneous media. J.W.Gardner

530.145

5861. NUCLEON–NUCLEON SCATTERING BY NON-CENTRAL FORCES. I. NEUTRON–PROTON SCATTERING. M.Gourdin.
J. Phys. Radium, Vol. 17, No. 12, 988-96 (Dec., 1956). In French.

A study of neutron–proton scattering, using a potential containing a tensor force. An exact calculation gives the expression for the differential cross-section as a function of Legendre polynomials. D.J.A.Prowse

530.145

5862. NUCLEON–NUCLEON SCATTERING BY NON-CENTRAL FORCES. II. PROTON–PROTON SCATTERING. M.Gourdin.
J. Phys. Radium, Vol. 18, No. 2, 85-91 (Feb., 1957). In French.

For Pt I, see preceding abstract. A study of proton–proton scattering with tensor forces by the aid of the exclusion principle of Pauli and the Coulomb potential. The differential cross-section is given for the P and F states when the higher angular moments are neglected. A.

530.145

5863. NOTE ON MULTIPLE SCATTERING THEORIES. H.Olsen.
K. Norske Vidensk. Selsk. Forhandl., Vol. 28, No. 1, 5-9 (1955).

A method is presented which includes the different treatments of Goudsmit and Saunderson (Phys. Rev., Vol. 57, No. 1, 24-9, Jan. 1, 1949) of Molière (Abstr. 609/1949), and of Snyder and Scott (Abstr. 6262/1949). W.A.Hepner

530.145

5864. INVERSION IN THE ISOBARIC SPIN SPACE. Y.Murai.
Nuclear Physics, Vol. 1, No. 9, 657-9 (Aug., 1956).

Following d'Espagnat and Prentki (Abstr. 2668/1956) an equivalent, simpler, formulation of the model of Nishijima and Gell-Mann is put forward. W.A.Hepner

530.145

5865. ON THE CHARGE INDEPENDENCE OF NUCLEAR FORCES. Riazuddin.
Nuclear Physics, Vol. 2, No. 2, 188-91 (Oct., 1956).

The possibility that the discrepancy between the zero-energy scattering lengths A_{NP}, A_{PP} for ^1S states of the NP and PP systems may be due to the mass difference between charged and neutral pions is investigated. A.

530.145

5866. CONNECTION BETWEEN SCATTERING AND MULTIPLE PRODUCTION OF PARTICLES. S.Z.Belenky.
Nuclear Physics, Vol. 2, No. 3, 259-66 (Nov., 1956).

According to Fermi's theory, multiple production of particles in high energy collisions should be determined by the statistical weight of the respective state. In the present investigation the statistical weight is calculated with account of mutual interaction of pairs of particles and it is shown that in this case the scattering phase of the interacting particles is involved as a characteristic of the interaction. In resonance scattering the effect of the interaction reduces to the appearance of an intermediate "isobaric" state which should be included in the statistical theory. A.

530.145

5867. COLLISION MATRIX FOR ROTATIONAL EXCITATION IN THE ADIABATIC APPROXIMATION. D.M.Chase.
Phys. Rev., Vol. 106, No. 3, 516 (May 1, 1957).

An expression is given for the collision matrix for rotational excitation of an axially symmetric scatterer in terms of the collision matrix for the related elastic scattering problem in the adiabatic approximation. A.

530.145

5868. THE EFFECTIVENESS OF VARIATIONAL METHODS FOR INELASTIC SCATTERING PROBLEMS. R.J.Huck.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 369-80 (May, 1957).

The calculation of a partial cross-section in atomic collision theory requires the solution of a pair of coupled integro-differential equations when the collision is inelastic and there is a possibility of particle exchange. A discussion is given of some variational procedures available for obtaining approximate solutions of such equations. These procedures are applied to the solution of two sets of model equations which simulate the equations of real problems but permit of exact solution. A comparison of exact and variational solutions enables the effectiveness of the variational methods to be assessed. It is found that a good approximation may be expected when trial functions are used which allow for the mixing of inelastically and elastically scattered waves, but that if only crude trial functions are used the approximation will be poor in cases where coupling is strong. A.

530.145

5869. ON THE HYDRODYNAMICAL DESCRIPTION OF THE BEHAVIOURS OF ELEMENTARY PARTICLES. M.Hamaguchi.
Progr. theor. Phys., Vol.15. No. 6, 588-90 (June, 1956).

The meson-field equation is re-written in a hydrodynamical form and hydrodynamical behaviour of the energy momentum tensor analysed. L.L.Green

530.145

5870. NUCLEON MAGNETIC MOMENTS IN PS–PS INTERMEDIATE COUPLING MESON THEORY.
A.Kanazawa and M.Sugawara.
Progr. theor. Phys., Vol. 16, No. 2, 95-111 (Aug., 1956).

Tomonaga intermediate-coupling meson theory is applied to the symmetrical ps–ps meson theory, taking account of the nucleon recoil, though non-relativistically, and the S-wave mesons, so as to give the pair damping automatically, besides the conventional P-wave mesons. Magnetic moments have been calculated, retaining up to three bound mesons and allowing virtual transitions to some excited states accompanied by single unbound meson emission. The results turn out to be too small to be consistent with the empirical values for reasonable cut-off momenta and coupling constants. Especially the effect of excited stated has been shown to be negligible. Sachs' theorem has been obtained as regards the bound meson contribution. A.

530.145

5871. EXTENSIONS OF VARIATIONAL METHODS. III. DETERMINATION OF POTENTIAL FROM PHASE SHIFT FUNCTION. T.Ohmura (formerly Kikuta).
Progr. theor. Phys., Vol. 16, No. 3, 231-43 (Sept., 1956).

For Pt II, see Abstr. 8008 (1956). The potential V(r) (of interest in the theory of scattering) is uniquely constructed from the phase-shift function $\eta_l(k)$ in any fixed value l of angular momentum under a certain condition on V(r), if the system has no bound state. The usual variational method is extended so as to give a variation principle for V(r) in that case. An integral equation of the following form is considered

$$A(k) = \int_0^\infty B(k,r)V(r)dr,$$

where A(k) and B(k,r) are determined by a trial function which is specified by a given $\eta_l(k)$. By means of this equation it is shown that V(r) can be calculated for any $r(\geq 0)$ accurately within errors of the order of Δ^2, while the errors involved in the trial function are of the order Δ. When the system has bound states the situation is more complicated, but the phase-shift $\eta_l(k)$ uniquely determines the potential for the system as well as the binding energies of all bound states, when a restriction is made to a potential of short range which is subject to the condition, $\lim V(r)e^{2\kappa r} \to 0$, as $r \to \infty$ $(\kappa > 0)$, where $-\kappa$ is the logarithmic derivative for the asymptotic wave-function of

the lowest level. The arguments given in the case of no bound state remain still valid for such a short-range potential. Some generalization of this method are proposed to include the tensor potential as well as the central one, which will make it possible to make use of known phase-shifts in the two-nucleon problem. A.

530.145

5872. ON THE ENERGY MATRIX OF THE TENSOR FORCES. T.Sasakawa.
Progr. theor. Phys., Vol. 16, No. 3, 256-8 (Sept., 1956).

Gives expressions for the matrix elements due to a tensor inter-nucleon force for the cases of two equivalent or two inequivalent nucleons J.W.G.Wignall

530.145

5873. THE OPTICAL THEOREM AND THE SMALL-ANGLE ELASTIC SCATTERING. L.I.Lapidus.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1099-101 (1956). In Russian.

Discusses different applications of the proportional relationship between the complete interaction cross-section and the imaginary component of the amplitude of the elastic forward scattering; this relationship, known also as the optical theorem, is true for particles with any spin. The inequality $\sigma(0^0) \geq k^2\sigma_t^2/16\pi^2$, where σ is the operator of the spin of the nucleon, is derived; it is applied to two examples of scattering. F.Lachman

530.145

5874. SOLUTIONS IN QUANTUM FIELD THEORY WITHOUT RECOURSE TO PERTURBATION METHODS. V.I.Grigor'ev.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 146-8 (1957). In Russian.

Proposes a formalism for the scattering matrix whereby the first and higher-order interactions do not appear separately but are included in the same functional integral. The form and evaluation of this integral are discussed for the case where all particles are fermions. J.W.Gardner

530.145

5875. MODEL OF A FIELD WITH INNER COORDINATES. W.Weidlich.
Z. Phys., Vol. 147, No. 2, 241-6 (1957). In German.

Yukawa's idea of using "inner" coordinates in a form function describing the structure of particles is applied to the scalar neutral meson field. A mass spectrum is derived, and the relation of the corresponding coupling constants (for interactions with sources at rest) with the form function is given. W.A.Hepner

530.145 : 531.01 : 538.3

5876. LAGRANGIAN FORMULATION AND MECHANICAL INTERPRETATION. M.Bunge.
Amer. J. Phys., Vol. 25, No. 4, 411-18 (April, 1957).

The question is asked whether, as is often claimed, the Lagrangian formulation of a physical theory provides its mechanical interpretation. For purposes of this enquiry, an analysis of physical theories is performed, with special emphasis on classical mechanics, electromagnetism, and quantum mechanics. Three aspects are distinguished and defined: the formulation (statement), the representation (transformation properties), and the interpretation (meaning). Confusion of formalism with meaning is criticized, and is suggested as a source of some misunderstandings of recent reinterpretations of quantum mechanics. Properties and advantages of Lagrangian formulations are listed, and it is recalled that their chief usefulness lies in that they are the most helpful precisely when mechanisms are either ignored or absent. It is concluded that Lagrangian formulations contribute to the demechanization of physics and that the programme of reduction to mechanics has not succeeded in physics. A.

530.145

5877. ON THE HYDRODYNAMICS OF IRROTATIONAL ELECTRON FIELDS. F.Möglich.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 230-6 (1956). In German.

The hydrodynamical equations of motion for a classical irrotational electron fluid can be transformed into a Schrödinger type wave equation which differs from the appropriate quantum-mechanical equation only in an additional term to the energy, and the undetermined magnitude of a constant of dimension "action". When this additional term is negligible compared to the other part of the energy the results of both classical and quantum theory agree. F.Ansbacher

530.145 : 530.12

5878. ON CONDITIONS OF RELATIVISTIC INVARIANCE IN QUANTUM THEORY. Yu.M.Shirokov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1223-6 (1956). In Russian.

In quantum theory it is necessary to combine the restricted principle of relativity with the Hamiltonian formulation of dynamics to obtain ten fundamental quantities: the 4-vector of total energy and momentum, and the 6-vector of angular momentum. Dirac (Abstr. 36/1950) has pointed out that conventional dynamics corresponds to one representation in which the six angular momentum components have a specially simple form. The present paper reviews other formalisms in which others of the ten fundamental quantities are specially simple, corresponding to various sub-groups of the inhomogeneous Lorentz group. J.W.Gardner

530.145

5879. QUANTIZATION OF THE RELATIVISTIC HARMONIC OSCILLATOR BY PERTURBATIVE METHODS WITH APPLICATION TO VAN DER WAALS FORCES. R.H.Penfield and H.Zatzkis.
J. Franklin Inst., Vol. 263, No. 4, 331-8 (April, 1957).

The relativistic effects on the quantization of the harmonic oscillator are determined from a perturbation calculation using matrices obtained in the nonrelativistic case. One finds that the energy levels are no longer evenly spaced although the usual transition rules still hold. When a system of two oscillators is considered and the relativistic modification together with radiation effects to second order on the energy of the system is determined, it is found that the higher-order correction terms to van der Waals forces are both repulsive and show a dependence on separation distance of $1/R^5$ and $1/R^7$. A.

530.145

5880. RELATIVISTIC COVARIANCE IN QUANTUM MECHANICS. II. O.Costa de Beauregard.
J. Phys. Radium, Vol. 17, No. 10, 872-5 (Oct., 1956). In French.

A further development of the improved formulation of the author's theory (Abstr. 932/1956). Results are expressed in more compact form by introducing an operator which transforms each solution of the Gordon equation into a solution for a free particle with spin. R.A.Newing

530.145 : 535.1

5881. QUANTUM THEORY OF DISPERSION AND THE KRAMERS–HEISENBERG FORMULA IN THE STATISTICAL OPERATOR FORMALISM. B.Unal and T.Kahan.
J. Phys. Radium, Vol. 17, No. 12, 1010-12 (Dec., 1956). In French.

Formal theoretical derivation of the formula by a perturbation approach. J.Hawgood

530.145

5882. CAUSALITY AND DISPERSION RELATIONS IN WAVE MECHANICS. E.Corinaldesi.
Nuclear Physics, Vol. 2, No. 4, 420-40 (Dec., 1956).

In this general review of non-relativistic and relativistic theories of scattering by short-range potentials, attention is paid to the formulation of causality requirements and to their application in the determination of dispersion relations. R.A.Newing

530.145 : 531.51

5883. ON THE QUANTUM FIELD THEORY OF THE INTERACTION BETWEEN THE GRAVITON AND THE MATTER FIELD. T.Kimura.
Progr. theor. Phys., Vol. 16, No. 3, 157-76 (Sept., 1956).

In order to quantize the gravitational field so as to be consistent with the general relativistic treatment, physical effects of the quantizable and unquantizable parts of gravitational field, when the matter fields exist, are studied. To construct the Hamiltonian, it is shown that the interaction Hamiltonian in the interaction representation can be obtained by a method extended from that of Yang–Feldman. The role of the non-linear part of gravitational field for such a problem is also discussed. Only the potential, obtained by eliminating the longitudinal and scalar parts of gravitational field with the aid of the supplementary condition, has an effect upon the macroscopical phenomena and gives the equation of two-body problem in general relativity found by Einstein, Infeld and Hoffmann. On the other hand, while the pure transverse graviton does not contribute to the macroscopical phenomena, it gives, in the region of high energy, the large damping effect upon the interaction between the elementary particles. A.

530.145 : 531.51

5884. ON THE QUANTUM FIELD THEORY OF THE INTERACTION BETWEEN THE GRAVITON AND THE MATTER FIELD. II. FORMULATION WITHOUT THE COORDINATE CONDITION. T.Kimura.
Progr. theor. Phys., Vol. 16, No. 6, 555-68 (Dec., 1956).

The quantum theory of Einstein's linear gravitational field interacting with the elementary particles is formulated without using the coordinate condition. The canonical formalism is built

up by the Dirac method of generalized Hamiltonian dynamics. It is necessary, for consistent quantization, that the operation of creation of a spinor particle should involve simultaneous creation of a spinor particle and of the gravitational potential around it. It is shown that this procedure of quantization corresponds to the method extended from the Yang–Feldman's in Pt I (see preceding abstract). In the Heisenberg representation the gravitational field is decomposed, in the usual covariant way, into three parts: the transverse graviton, the gravitational potential between the matters, and the part which cannot be quantized. And also the formalism in the Heisenberg representation is transformed into the one in the interaction representation, and the same interaction Hamiltonian is obtained as in Pt I. A.

530.145 : 533.7

5885. USE OF A GENERAL VIRIAL THEOREM WITH PERTURBATION THEORY. W.J.Carr, Jr.
Phys. Rev., Vol. 106, No. 3, 414-17 (May 1, 1957).

If the Hamiltonian of a system is broken up into a series of homogeneous operators in the space coordinates, the sum of their mean values multiplies by the degree of homogeneity equals zero for a bound state. Assume that the Hamiltonian contains three groups of homogeneous terms: for example, kinetic energy, Coulomb energy and a third interaction, U, which is small. By the "virial" theorem, the energy can be expressed in the mean values of any two of these terms. From perturbation theory, another relationship is derived which allows various orders of the energy to be obtained from the mean value of any one of the three terms of the Hamiltonian. The perturbation relation is $\bar{U} = \Sigma\, nE_n$, where E_n is the nth order correction to the energy, defined by $E = \Sigma E_n$. A.

530.145

5886. ON THE PERTURBATION THEORY OF SMALL DISTURBANCES. A.Dalgarno and A.L.Stewart.
Proc. Roy. Soc. A, Vol. 238. 269-75 (Dec. 18, 1956).

As a preliminary to a wide range of applications, conventional perturbation theory is re-examined and a number of useful properties emphasized. It is shown in particular that the total, kinetic and potential energies can be obtained to the (2s+1)th order from a knowledge of only the s-th-order wave-function and that similar though less powerful theorems hold for other diagonal matrix elements. A combination of variational and perturbation techniques is suggested as the best method of calculating small disturbances of a stationary system. A.

530.145

5887. COLLECTIVE MOTION IN QUANTUM MECHANICS. T.H.R.Skyrme.
Proc. Roy. Soc. A, Vol. 239, 399-412 (March 12, 1957).

A general method of discussing quantum-mechanical problems involving collective motion is proposed, in which the emphasis is placed on consideration of sets of states rather than single states, and in which the additional collective coordinates are not redundant but used to describe the sets. The method is applied to a number of relatively simple examples: plasma oscillations of an electron gas; some problems of nuclear structure including the α-particle model and the collective model; and to two problems in meson field theory, concerning nucleon isobars in strong-coupling theory and concerning nucleon recoil. One of the main aims is to determine as well as possible the parameters of the collective motion; in particular, a formula is given for the moment of inertia of a rotating system. A.

530.145

5888. A CLASSICAL THEORY OF THE COLLECTIVE DESCRIPTION. Y.Watanabe.
Progr. theor. Phys., Vol. 16, No. 1, 1-22 (July, 1956).

An elementary theory is developed of a classical treatment with the "collective motion" of many-particle systems. The fundamental concept of collective motion can be reduced into a certain transformation property of the Hamiltonian. Regarded as dynamical variables, the continuous parameters of such a transformation describe the collective motion of the system, while the individual motions are partly suppressed by the same numbers of subsidiary conditions, or constraints, logically derived, as the numbers of transformation parameters. Then the general procedure of formulation is illustrated; as an example, the incompressible motion with three modes can be systematically formulated. As another examples the unified treatment is performed also with the vortex motion. A.

530.145

5889. CONSTRAINT IN A QUANTUM SYSTEM. Y.Watanabe.
Progr. theor. Phys., Vol. 16, No. 5, 534-6 (Nov., 1956).

The effect of constraints, as distinct from subsidiary conditions, is investigated. W.A.Hepner

530.145

5890. SCALE TRANSFORMATION AND VIRIAL THEOREM IN QUANTUM FIELD THEORY. Yu.V.Novozhilov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 171-3 (1957). In Russian.

The virial theorem follows as a natural consequence of a scale transformation applied to the equations of quantum field theory. J.W.Gardner

530.145

5891. REMARKS ON THE VALIDITY OF THE HYDRODYNAMIC DESCRIPTION OF QUANTUM SYSTEMS. D.I.Blokhintsev.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 350-2 (1957). In Russian.

It is shown that the hydrodynamic description of quantum systems imposes some serious restrictions on the dimensions of the investigated system. A result of this is that this description is invalid for atomic nuclei or multiple creation of mesons at the initial stages of expansion of the meson liquid. A.

530.162

5892. SPECTRUM OF FREQUENCIES OF A DISORDERED LINEAR CHAIN. J.des Cloizeaux.
J. Phys. Radium, Vol. 18, No. 2, 131-2 (Feb., 1957). In French.

The spectrum of frequencies of the normal modes of vibration of a disordered linear chain has been calculated by Dyson by the method of moments. Identical results are obtained by a different method which proceeds directly to the basic differential equations by introducing the concept of phase advance. G.Allen

530.162

5893. INTEGRAL OVER PATH FORMULATION OF STATISTICAL THEORY OF IRREVERSIBLE PROCESSES. D.Falkoff.
Progr. theor. Phys., Vol. 16, No. 5, 530-2 (Nov., 1956).

530.162

5894. STOCHASTIC BASIS OF THE EULERIAN VARIATIONAL PRINCIPLE IN LINEAR DISSIPATIVE PROCESSES. A.Siegel.
Phys. Rev., Vol. 106, No. 4, 609-15 (May 15, 1957).

The application of the Eulerian variational method to the Onsager Lagrangian of a linear dissipative process implies that variables undergoing strong spontaneous fluctuations (i.e., following curves other than the characteristic exponential decay from a given initial value) obey, on a macroscopic time scale a simple differential equation which also describes the more usual exponential decay curve. To justify this from the stochastic model of such processes suggested (Abstr. 420-1/1954) by Onsager and Machlup (according to which the variable obeys the Langevin equation) requires that two things be proved: (1) as a necessary condition, that the stochastic curves under the given conditions do indeed cluster strongly about the solution of the differential equation; (2) as a sufficient condition, that the approximate time integral (actually obtained as a finite sum) of the Onsager Lagrangian be close to its relative minimum, for a time subdivision that is fine in the macroscopic sense. (1) is proved by deriving the conditional probability density of the Langevin variable at a time intermediate between two other times, given the values of the variables at these times. The proof of (2), which utilizes this distribution function, follows lines similar to the more special case previously treated by the author. A.

530.162

5895. INFORMATION THEORY AND STATISTICAL MECHANICS. E.T.Jaynes.
Phys. Rev., Vol. 106, No. 4, 620-30 (May 15, 1957).

Information theory provides a constructive criterion for setting up probability distributions on the basis of partial knowledge, and leads to a type of statistical inference which is called the maximum-entropy estimate. It is the least biased estimate possible on the given information; i.e., it is maximally noncommittal with regard to missing information. If one considers statistical mechanics as a form of statistical inference rather than as a physical theory, it is found that the usual computational rules, starting with the determination of the partition function, are an immediate consequence of the maximum-entropy principle. In the resulting "subjective statistical mechanics", the usual rules are thus justified independently of any physical argument, and in particular independently of experimental verification; whether or not the results agree with experiment, they still represent the best estimates that could have been made on the basis of the information available. It is concluded that statistical

mechanics need not be regarded as a physical theory dependent for its validity on the truth of additional assumptions not contained in the laws of mechanics (such as ergodicity, metric transitivity, equal a priori probabilities, etc.). Furthermore, it is possible to maintain a sharp distinction between its physical and statistical aspects. The former consists only of the correct enumeration of the states of a system and their properties; the latter is a straightforward example of statistical inference. A.

530.162

5896. ON THE QUANTUM MECHANICS-LIKE DESCRIPTION OF THE THEORIES OF THE BROWNIAN MOTION AND QUANTUM STATISTICAL MECHANICS. N.Saitô and M.Namiki.
Progr. theor. Phys., Vol. 16, No. 2, 71-94 (Aug., 1956).

Analogies among the theories of Brownian motion, quantum mechanics and quantum statistics are pointed out from various aspects. Quantum-mechanics-like descriptions of Brownian motion and quantum statistics are presented. A.

530.162

5897. EQUATIONS WITH VARIATIONAL DERIVATIVES IN PROBLEMS OF STATISTICAL PHYSICS AND QUANTUM FIELD THEORY. N.N.Bogolyubov.
Vestnik Moskov. Univ., Vol. 10, No. 4-5, 115-24 (1955). In Russian.

A lecture surveying the field of variational equations in physics. The main thesis is that the method of variational differentiation, introduced into quantum field theory by J.Schwinger (Abstr. 64-65/1952) can be used equally well in classical statistical mechanics. Mathematical Reviews

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.01 : 538.3 : 530.145

LAGRANGIAN FORMULATION AND MECHANICAL INTERPRETATION. See Abstr. 5876

531.35

5898. INEXPENSIVE APPARATUS FOR THE STUDY OF CIRCULAR MOTION. E.P.Clancy.
Amer. J. Phys., Vol. 25, No. 1, 41 (Jan., 1957).

The laboratory experiment for the study of circular motion, in which the centripetal force on a rotating mass is determined, demands the maintenance of a speed of rotation suitably uniform during the run. This has now been made possible by use of a variable speed friction drive rotator mechanism which provides the continual critical adjustment necessary. Details with illustration of this inexpensive device are given. H.H.Hodgson

531.353

5899. NOTE ON THE PRINCIPAL FREQUENCIES OF A DOUBLE SPRING—MASS SYSTEM. H.S.C.Chen.
Amer. J. Phys., Vol. 25, No. 5, 311-12 (May, 1957).

This paper gives an algebraic solution for the principal frequencies of a double spring—mass system. A comparison of numerical results is given. A.

531.353 : 531.51

5900. ON THE PROBLEM OF THREE BODIES IN THE PLANE. J.F.Steffensen.
K. Danske Vidensk. Selsk., mat.-fys. Medd., Vol. 31, Paper 3, 18 pp. (1957).

Three bodies with finite masses are assumed to move in a plane, subject to Newton's law of gravitation. By the introduction of suitable auxiliary variables the equations of motion are transformed into a system of differential equations of the second degree, permitting to expand the unknown quantities in powers of the time t, the coefficients of t^ν being calculated by means of a set of recurrence formulae. Sufficient conditions for the convergence of the resulting series are given, and the practical working of the method is illustrated by a numerical example. A.

531.539

5901. HORIZONTAL PENDULUM WITH VARIABLE MODULUS OF TORSION (RESONANCE CURVE). J.De Smedt and A.De Bock.
Amer. J. Phys., Vol. 25, No. 3, 155-6 (March, 1957).

A didactical apparatus for accurate determination of resonance curves is presented. A bifilarly suspended disk, whose natural period is variable between large limits while the system is oscillating, is suited for easy determination of a resonance curve, because the period of the forced oscillation can remain unchanged during operation. The rigidity and hence the natural period of the pendulum is altered by a change in the mass supported by the bifilar suspension; this is done by means of a third axial wire, from the disk to a yoke carrying counterweights. A.

MECHANICAL MEASUREMENTS 531.7

531.715.2

5902. PHOTOMETRIC DETERMINATION OF THICKNESS OF SEMITRANSPARENT METAL LAYERS.
L.S.Palatnik and G.V.Fedorov.
Dokl. Akad. Nauk SSSR, Vol. 113, No. 1, 100-3 (1957). In Russian.

531.717.1 : 535.51

5903. IMPROVED METHOD TO MEASURE THE THICKNESS OF THIN FILMS WITH A PHOTOELECTRIC ELLIPSOMETER.
A.Rothen.
Rev. sci. Instrum. Vol. 28, No. 4, 283-5 (April, 1957).

See Abstr. 2451 (1949). Describes the advantages of a photoelectric ellipsometer over a visual instrument for the measurement of the thickness of films from 1 A up to many thousand A. Experimental curves are given showing the unambiguous correlation between film thickness and position of two rotating elements, a $\lambda/4$ plate and an analysing Nicol prism. A.

531.752 : 533.59

A NEW QUARTZ MICROBALANCE FOR USE IN THE HIGHEST VACUUM. See Abstr. 5926

531.771.1 : 535.345.08 : 535.325.08

THE MEASUREMENT OF THE THICKNESS AND THE OPTICAL CONSTANTS OF VERY THIN METAL FILMS. See Abstr. 5969

531.787

5904. PRECISE AUTOMATIC MANOMETER READER.
J.Farquharson and H.A.Kermicle.
Rev. sci. Instrum., Vol. 28, No. 5, 324-5 (May, 1957).

An instrument has been developed which automatically finds the level of mercury in a glass tube and indicates on a digital register the height of the mercury column. The first model has a range of 80 cm, a precision of better than ±0.05 mm and a maximum deviation of ±0.11 mm. The range and deviation depend upon the length and linear accuracy of the metric screw. A.

MECHANICS OF FLUIDS 532

532.122

5905. ON THE STRUCTURAL PART OF THE COMPRESSIBILITY OF LIQUIDS. V.S.Venkatasubramanian.
J. chem. Phys., Vol. 26, No. 4, 965 (April, 1957).

Frenkel postulated that the compressibility β_T of a liquid is the sum of the geometrical part (decrease of average intermolecular distance) and the structural part (alteration of intramolecular arrangement) i.e. $\beta_T = \beta_T^g + \beta_T^s$. It is shown that the structural part can be expressed in terms of the temperature coefficient of compressibility. The relative contributions of the two parts are given for a number of liquids and the following observations made: (1) In most liquids $\partial\beta_T/\partial T$ and β_T^s are positive (2) $|\beta_T^s| \cong 2x|\beta_T^g|$ (3) β_T^g is usually negative. Water is an exception from 0°-6° C which can be associated with the structural change tridymite to ice-like. (Bernal and Fowler). T.C.Toye

532.122

5906. COMPRESSIBILITIES OF SODIUM AND POTASSIUM HYDROXIDES. J.Bhimasenachar and S.V.Subrahmanyam.
Nature (London), Vol. 179, 627-8 (March 23, 1957).

Gucker (Chem. Rev., Vol. 13, 111, 1933) gave a relation for apparent molar compressibility in electrolytes while Bachem (Z. Phys., Vol. 101, 541, 1936) derived a relation for the adiabatic compressibility. Determination of these two parameters, in the case of solutions of sodium and potassium hydroxides up to approximately 7.5 mol/litre, from experiments on ultrasonic velocity indicates the validity of the Gucker relation over the whole range. The adiabatic compressibility is given by the Bachem equation provided two sets of constants are used to cover the complete concentration range. T.C.Toye

532.13

5907. BULK VISCOSITY OF CERTAIN ORGANIC LIQUIDS AND ITS TEMPERATURE VARIATION. T.M.Ledneva.
Vestnik Moskov. Univ., No. 2, 49-60 (1956). In Russian.

The viscosity coefficients are derived from measurements of the absorption coefficient of ultrasonic waves over a wide range of temperatures and pressures. Tables and graphs of viscosity coefficient v. temperature are given for a number of paraffins, toluol and some alcohols. It is found that the formula put forward works well for alcohols over the experimental range.

C.R.S.Manders

532.137

5908. DIDACTICAL ABSOLUTE VISCOSIMETER.
J.De Smedt and A.De Bock.
Amer. J. Phys., Vol. 25, No. 3, 152-4 (March, 1957).

A didactical apparatus for the absolute measurement of small coefficients of viscosity (1 centipoise) with an accurancy of 1% is presented. A W-shaped piece rotates about a vertical axis at a variable distance from the walls of an identically shaped vessel, containing the liquid sample. A wire wound on a drum attached to the axis, carries a mass, which accelerates the rotor when falling through a distance H in the time interval T. When completely unrolled the wire is rewound on the drum and the mass is lifted up to a smaller height H' in a shorter time T'. The determination of both distances and time intervals permits calculation of the coefficient of viscosity. A.

532.511 : 541.124

5909. HYDRODYNAMICS OF A REACTING AND RELAXING FLUID. W.W.Wood and J.G.Kirkwood.
J. appl. Phys., Vol. 28, No. 4, 395-8 (April, 1957).

General equations governing the hydrodynamic behaviour of an ideal compressible fluid in which chemical reactions and internal relaxations proceed are formulated. For one-dimensional flow the equations are transformed to characteristic form, in which the "frozen" or high-frequency sound velocity plays a role analogous to the unambiguous sound velocity in the nonreactive case. A.

532.517.3

5910. ON TRANSITION FROM LAMINAR TO TURBULENT FLOW. F.R.Hama, J.D.Long and J.C.Hegarty.
J. appl. Phys., Vol. 28, No. 4, 388-94 (April, 1957).

Water-tank observations of the flow phenomena associated with boundary-layer transition have revealed that a two-dimensional discrete vortex line, which is considered to be the consequence of an amplified perturbation wave, has a strong tendency, in shear flows, to form three-dimensional vortex loops with a marked transverse wavelength. The formation and development of the vortex loop is found to be the essential feature preceding the creation of a turbulent spot which takes place near the top of the vortex loop and near the outer edge of the boundary layer. This formation and development provides the guiding principle of laminar-to-turbulent transition in wakes and jets as well as in the boundary layer. A.

532.59

5911. A RELATION BETWEEN PHASE VELOCITY, PARTICLE VELOCITY AND ENERGY FOR PROGRESSIVE PERMANENT WAVES. H.Ertel.
S.B. Dtsch. Akad. Wiss. Berlin, Kl. Math. Phys. Tech., No. 2, 5-12 (1956). In German.

In the case of surface waves on a perfect fluid, the two velocities are such that $\vec{c}.\vec{v} = E$, where E is the total energy per unit mass. The analogy with de Broglie waves is noted.

R.A.Newing

CAPILLARITY 532.6

532.612

5912. ON SURFACE TENSION OF IDEAL SOLUTIONS. J.Stecki.
Acta phys. Polon., Vol. 15, No. 4, 267-9 (1956).

An equation presented by Mierzecki (Abstr. 7182/1956) is questioned by the author of the present letter. It is claimed that the theoretical assumptions are unsound and a short critical review of the problem generally is then given. Association and the influence of complexes is considered important, it being thought that a suitable model would be similar to Prigogine's associated solution model.

T.C.Toye

532.612.4

5913. SURFACE TENSION—TEMPERATURE RELATION FROM FREE-VOLUME CONCEPT. S.S.Mitra.
Indian J. Phys., Vol. 30, No. 8, 423-7 (Aug., 1956).

By applying the concept of free volume in liquids, the temperature variation of surface tension has been explained. Similarity in the behaviour of surface tension with that of viscosity and vapour pressure has been traced out and thereby a logarithmic type of equation has been suggested, a justification of which has been furnished from the free-space concept. The equation is

$$\log S = a + (b/T) - c \log T$$

being of the same type as those of Kirchoff's vapour pressure and Eyring's viscosity equations, though derived from somewhat different standpoints. A.

532.62

5914. SHAPE OF A LIQUID INTERFACE. A.G.Thomas.
Nature (London), Vol. 179, 776 (April 13, 1957).

In the determination of molecular areas of adsorbed films at an interface it is necessary to know exactly the true interfacial area. A formula is derived for calculating the true area for a given vessel size in terms of the radius of curvature. It is shown, for example, that in the case of water in a vessel 10 cm x 10 cm the correction is as much as 6.7%. The formula has been verified by experiment for water, benzene and decane. T.C.Toye

532.65 : 551.574.1

5915. THEORY OF THE LARGE-DISTANCE INTERACTION BETWEEN EVAPORATING OR GROWING DROPS.
S.S.Dukhin and B.V.Deryagin.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 3, 407-11 (1957). In Russian.

In a previous paper (Deryagin and Dukhin, Dokl. Akad. Nauk SSSR, Vol. 106, No. 5, 851, 1956) the authors evaluated the forces of attraction or repulsion, acting between the fog droplets or between a drop and a continuous liquid surface and affecting considerably the motion of the drops in relation to the medium. In the first approximation, however, the forces of diffusion were found to be compensated by the effect of Stefan's flux. In the present paper the authors introduce the factor of heat transfer which, as a rule, disturbs this compensation; the diffusion forces are shown to be able to influence substantially the precipitation and coagulation of the aerosols.

F.Lachman

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 533.7 : 534.22

MOLECULAR ABSORPTION AND DISPERSION OF SOUND IN FLUIDS. See Abstr. 5128

532.7 : 534.23

EFFECTS OF PRESSURE ON ULTRASONIC RELAXATION IN LIQUIDS. See Abstr. 5136

532.7 : 534.23

THEORY OF ULTRASONIC THERMAL RELAXATION TIMES IN LIQUIDS. See Abstr. 5137

532.71

5916. TRANSIENT FLUID MOTIONS IN SATURATED POROUS MEDIA. J.R.Philip.
Austral. J. Phys., Vol. 10, No. 1, 43-53 (March, 1957).

The transition from rest to steady motion on the sudden application of a potential gradient to the fluid contained in a saturated porous medium is investigated. An approximate analysis gives the result that the time of the effective establishment of the steady motion is proportional to the permeability and inversely proportional to the kinematic viscosity. Two exact solutions (one of them new) for simple cases suggest that the approximate analysis is remarkably accurate. An analogy between this problem and one in heat conduction makes the relevant results in that field immediately applicable here. The analysis is extended to motion with the time variation of the applied potential gradient quite general. Certain properties of the motion when the potential varies periodically are determined, and the simple harmonic case is studied in some detail. It is found that the error in using Darcy's law (which neglects the transient phase) will usually be unimportant for the case of a suddenly applied potential gradient. However, significant deviations from Darcy's law may

occur when the applied potential gradient is periodic, even for systems of quite low frequency. The equations derived from the approximate analysis may be regarded as generalizations of Darcy's law which take into account time variation of the applied potential gradient. A.

532.73

5917. VOLUME OF MIXING IN MIXTURES OF CYCLOHEXANE–CYCLOHEXANOL. R.P.Rastogi and K.T.R.Varma.
J. chem. Phys., Vol. 25, No. 5, 1077 (Nov., 1956).

The excess volume function for these mixtures has been calculated by applying the theory of Prigogine (Abstr. 4240/1956). The theoretical curve follows the experimental one closely; the change of sign of the function is correctly predicted. W.Good

532.73

5918. THEORY OF SOLUTIONS. T.L.Hill.
J. chem. Phys., Vol. 26, No. 4, 955-6 (April, 1957).

An outline of a thermodynamic theory of solutions which it is claimed will give expansions of chemical potentials, partial molal volumes, heat contents and entropies in powers of the molality of the solute. The theory has been successfully tested on a number of different models. T.C.Toye

532.739.2

5919. ACCURATE MEASUREMENT OF GAS SOLUBILITY. M.W.Cook and D.N.Hanson.
Rev. sci. Instrum., Vol. 28, No. 3, 370-4 (May, 1957).

An apparatus and a technique accurate and reproducible to 0.1%, have been developed for measuring the solubility of gases in liquids. The criteria necessary for measurements of this accuracy have been established and examined individually in order to provide a systematic approach to the design of gas solubility apparatus. A.

532.74 : 534.23

5920. THEORY OF THE EQUATION OF STATE AND ULTRASONIC ABSORPTION IN ASSOCIATED LIQUIDS AT ORDINARY TEMPERATURES. R.E.Nettleton.
Phys. Rev., Vol. 106, No. 4, 631-7 (May 15, 1957).

The thermodynamic affinity is calculated for structural relaxation in a liquid and coupled to the diagonal elements of the stress tensor according to a theory by Meixner (Abstr. 5577/1952). It is shown how another term, the "hydrostatic pressure" of hydrodynamics, may be calculated once all the affinities are known. The equation of state may thus be determined near equilibrium. Calculations of ultrasonic absorption are presented for water and ethyl alcohol. In ethyl alcohol, thermal relaxation is found to be the dominant dissipative mechanism. A.

532.783 : 537.226.2

5921. MICROWAVE DIELECTRIC MEASUREMENTS IN LIQUID CRYSTALS. E.F.Carr.
J. chem. Phys.,Vol . 26, No. 2, 420-2 (Feb., 1957).

The real and imaginary parts of the complex dielectric constant of the liquid crystal and normal liquid phases of anisaldazine and a mixture of p-azoxyanisole and p-azoxyphenetole have been measured at a frequency of 14 400 Mc/s. The presence of a static magnetic field produces large changes in the observed values of the complex dielectric constant, which depend on the orientation of the magnetic field and on the temperature. A.

532.783

5922. THE STRUCTURE OF LIQUID METALS. I.V.Radchenko.
Uspekhi fiz. Nauk, Vol. 61, No. 2, 249-76 (1957). In Russian.

Order–disorder relationships are discussed and the information to be derived via X-ray analysis briefly indicated. The results of X-ray and neutron diffraction studies made by the many workers (111 references) are then collated for (a) Hg, (b) metals with densely packed atoms in the solid state (Au, Pb, Tl, In, Cd, Al, Zn), (c) alkali metals (Na, K, Li), (d) metals with lightly packed atoms in the solid state (Ga, Bi, Ge, Sb, Se, Te, Sn). It is concluded (i) that the atomic packing in liquid metals is connected in known manner with that in the solid state, (ii) that the coordination number of all metals on melting is either increased or unchanged, and (iii) that intensity curves show the type of packing is conserved to temperatures considerably exceeding the melting point. Directions in which further study is required are indicated. C.R.S.Manders

MECHANICS OF GASES 533

533.56

5923. MOLECULAR PUMPS AT VERY LOW PRESSURES. EXTENSION TO HIGH ROTATING SPEEDS. C.Mercier and P.Benoist.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 182A-183A (Nov., 1956). In French.

Formulae obtained in an earlier paper (Abstr. 4877/1956) are modified when the peripheral speed of the rotor is not negligible compared with molecular velocities. Numerical calculations show that the maximum permissible ratio of the pressures on either side of a molecular pump increases rapidly with the peripheral speed of the rotor. M.E.Haine

533.59

5924. PROTECTIVE CIRCUIT FOR VACUUM PLANTS PERMANENTLY CONNECTED TO THE PUMPS. J.Conard.
C.R. Acad. Sci. (Paris), Vol. 244, No. 1, 52-4 (Jan. 2, 1957). In French.

The vacuum plant consists of fore pumps and a water-cooled oil diffusion pump. The secondary vacuum pressure is controlled and measured by a Penning gauge, and the protective system can be set to operate when the pressure rises above any value between 10^{-5} to 10^{-2} mm mercury. Protection is given also for failure of electrical and water supplies. S.Weintroub

533.59

5925. CONTAMINATION GAUGE. E.O.Johnson.
Rev. sci. Instrum., Vol. 27, No. 12, 1084-5 (Dec., 1956).

Contamination of noble gases by very small amounts of O_2, H_2O or hydrocarbon vapours is detected by the fall in thermionic emission of a tungsten filament. K.W.Plessner

533.59 : 531.752

5926. A NEW QUARTZ MICROBALANCE FOR USE IN THE HIGHEST VACUUM. H.Mayer and K.Behrndt.
Z. Phys., Vol. 147, No. 4, 499-506 (1957). In German.

After outlining the essential requirements for a microbalance suitable for the weighing of thin evaporated films in vacuo, a robust form of quartz microbalance which can be entirely enclosed within the vacuum chamber and which consists of a 14 cm long balance beam with a balance pan of area 2.86 cm^2, is described in detail. The balance is controlled magnetically from outside the chamber. The calibration curve, obtained using pieces of Al wire, is given and shows that a sensitivity of the order of 10^{-8} g/mm can be attained. S.Weintroub

533.6.011.4

5927. ON SUPERSONIC FLOW BEHIND A CURVED SHOCK. R.E.Meyer.
Quart. appl. Math., Vol. 14, No. 4, 433-6 (Jan., 1957).

A solution to the flow problem is presented which accounts approximately for the entropy gradients and vorticity downstream of the shock. The flow downstream is a simple wave in which the entropy and a characteristic parameter, α, of homentropic theory have the values occurring just on the nose in the real flow. The solution is obtained on the approximation that α is constant along streamlines. It predicts the same pressure on the body as shock-expansion theory. L.S.Goddard

MOLECULAR THEORY OF GASES 533.7

533.7

5928. ON THE THEORY OF A REAL GAS WITH NON-CENTRAL LAW OF PARTICLE INTERACTION. A.E.Glauberman.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 63-6 (1956). In Russian.

Tensor forces in a system of molecules with permanent and induced dipole moments are formulated quite generally in terms the sum of interactions between a given molecule and all other molecules. By limiting the summation to neighbouring interactions a good first approximation to the electrostatic energy is obtained in a particular case. J.W.Gardner

533.7

5929. EQUATIONS FOR A LATTICE GAS. I. ONE COMPONENT SYSTEMS. H.B.Levine, J.E.Mayer and H.Aroeste.
J. chem. Phys., Vol. 26, No. 1, 201-6 (Jan., 1957).

An expression is developed for P/kT for a lattice gas with an arbitrary lattice as a power series in the nearest neighbour interaction parameter, λ, with the coefficients functions of the activity, z. This result is applied in some detail to the cubic close packed lattice, for which expressions for the number density, ρ, and the probability of finding a cell adjacent to a filled cell also filled, $\rho\nu$, are also given. These results are also transformed so as to give P/kT, $\ln z$, and ν as power series in λ with the coefficients functions of ρ. A development for P/kT for an arbitrary lattice with different interactions for different distances between lattice sites is also given. The equation permits numerical evaluation without too great difficulty. A.

533.7

5930. AN APPROXIMATION FOR THE RADIAL DISTRIBUTION FUNCTION. A.E.Rodriguez.
Proc. Roy. Soc. A, Vol. 239, 373-81 (March 12, 1957).

The present paper is concerned with a new approximation for the distribution function of third order. This approximation may be regarded as an improved form of the well-known superposition assumption of Kirkwood. The idea is to add to Kirkwood's expression a linear combination of distribution functions of the same type, the coefficients of which can be easily determined. The new approximation is introduced in the Born—Green integral equation for the radial distribution function, for which an expansion into powers of the density is used. From this the terms proportional to the first and second power of the density are calculated. The first four virial coefficients can be expressed as functions of these terms, whether the pressure equation or the compressibility equation is used. Numerical evaluation is performed for the ideal case of a gas of rigid spheres. The value obtained for the fourth virial coefficient is compared with the exact one and those given by using Kirkwood's assumption by Rushbrooke and Scoins, and Nijboer and van Hove. It is seen to be more nearly exact and internally consistent. The term proportional to the square of the density, in the expansion of the radial distribution function, appears to be very similar to the exact one as calculated by Nijboer and van Hove. It can be seen to be better than the corresponding term when Kirkwood's assumption or one proposed by Nijboer and van Hove is used. Finally, an alternative assumption is suggested, and applied to the case of hard spheres. A.

533.7 : 530.145

USE OF A GENERAL VIRIAL THEOREM WITH PERTURBATION THEORY. See Abstr. 5885

533.7 : 532.7 : 534.22

MOLECULAR ABSORPTION AND DISPERSION OF SOUND IN FLUIDS. See Abstr. 5128

533.72

5931. LAW OF ATMOSPHERES. A.B.Stewart.
Amer. J. Phys., Vol. 25, No. 2, 116-17 (Feb., 1957).

The exponential distribution of particles in a uniform field at constant temperature (the law of atmospheres) is considered as a consequence of a steady-state balance of particles diffusing against the field and of those drifting with the field. The method is claimed to afford added insight into the dynamic processes that produce the steady-state exponential distribution. H.H.Hodgson

533.75

5932. CONNECTION BETWEEN PAIR DENSITY AND PRESSURE FOR A BOSE GAS CONSISTING OF RIGID SPHERICAL ATOMS. M.Fierz.
Phys. Rev., Vol. 106, No. 3, 412-13 (May 1, 1957).

It is shown that, for a Bose gas of rigid spherical atoms of radius a, the pressure p is given by the pair-density g(r) and the energy per atom u by the formula $p/\rho T = \frac{2}{3}u/T + \frac{2}{3}\pi a^3 \cdot \frac{1}{2}mT \cdot g''(a)$. A.

VIBRATIONS. ACOUSTICS 534

534.01

5933. SYNCHRONIZATION OF THE EXTERNAL FORCE OF TWO CONNECTED SELF-OSCILLATORY SYSTEMS. R.V.Khokhlov.
Vestnik Moskov.Univ., No. 3, 41-9 (1956). In Russian.

There is a considerable current interest in oscillation generators consisting of several interconnected self-oscillatory systems of the Thompson type. Under specified conditions the qualities of such generators are a notable improvement upon those of partial systems. One important property of a self-oscillatory system is its ability to synchronize, thus determining its behaviour under the action of an external force. The present paper is devoted to a theoretical investigation of the synchronization of the small sinusoidal force of two weakly-connected self-generators. The cases are discussed of systems where the powers differ widely and where the powers are close to one another. C.R.S.Manders

534.131

5934. INTERPRETING CHLADNI FIGURES. M.D.Waller.
Amer. J. Phys., Vol. 25, No. 3, 157-8 (March, 1957).

Jensen's recently published Chladni figures can be interpreted as normal modes of vibration with antinodal centres which are distorted by the experimental method employed to produce them. The free transverse vibrations of uniform plates always conform with the symmetry of the geometrical surfaces. The principle of symmetry and of corresponding vibrations enables them to be identified and arranged in a systematic manner. The solid carbon dioxide method of exciting free vibrations, supplemented by the bow, produces the most symmetrical figures. A.

534.131

5935. PRODUCTION OF CHLADNI FIGURES. H.C.Jensen.
Amer. J. Phys., Vol. 25, No. 3, 203 (March, 1957).

Discusses the methods used by M.D.Waller to produce Chladni figures on metal plates. It is demonstrated that sharply defined patterns can be obtained using loudspeaker excitation as well as by bowing and by the use of solid carbon dioxide excitation. It possesses the additional advantage that the loudspeaker method can be used to produce patterns on any material, not necessarily metallic, whereas the success of the carbon dioxide method is dependent on the heat conductivity of the material. A.B.Wood

534.131 : 517.9

UNIFIED TREATMENT OF THE VIBRATING ARM. See Abstr. 5788, 5789

534.2

5936. FLUX OF ENERGY FOR ELASTIC WAVES IN ANISOTROPIC MEDIA. J.L.Synge.
Proc. Roy. Irish Acad. A, Vol. 58, No. 2, 13-21 (Nov., 1956).

The flux of energy in an infinite horizontal slab of anisotropic material with a free upper face and a lower face subjected to travelling waves of stress is considered, using tensor notation. It is shown that there are six systems of plane waves and their behaviour is described as the velocity of the waves of applied stress is reduced. Generalized Rayleigh waves are obtained as a limiting case. H.J.H.Starks

534.213

5937. THE INTERACTION OF AN ACOUSTIC WAVE AND AN ELASTIC SPHERICAL SHELL. P.Mann-Nachbar.
Quart. appl. Math., Vol. 15, No. 1, 83-93 (April, 1957).

The effect of the impact of a plane pressure wave on an elastic spherical shell is considered, taking into account both the incident and diffracted waves. An infinite series (mode) solution is used and numerical results are obtained for the case of a steel shell in water. It is shown that a simple quasistatic system can be used to find a very good approximation for the stress. The total acceleration on initial impact is found exactly and seen to differ markedly from the accelerations associated with the lower vibrational modes. A.

534.213 : 536.48

OSCILLATIONS OF A FERMI LIQUID. See Abstr. 5279

534.22/.23

5938. ERRATA: TABULAR DATA OF THE VELOCITY AND ABSORPTION OF HIGH-FREQUENCY SOUND IN MAMMALIAN TISSUES. D.E.Goldman and T.F.Hueter.
J. Acoust. Soc. Amer., Vol. 29, No. 5, 655 (May, 1957).
See Abstr. 1913 (1956).

534.22

5939. ON A DERIVATION OF THE EQUATION FOR THE SPEED OF SOUND BY W.W.SLEATOR. A.J O'Leary.
Amer. J. Phys., Vol. 25, No. 2, 115-16 (Feb., 1957).

The purpose of the note is to point out two basic errors in a derivation of the equation for the speed of sound by W.W.Sleator (J.Opt. Soc. Amer., Vol. 21, 187, 1931, and Amer. J. Phys., Vol. 17, 51 and 178, 1949) which has recently been repeated (Abstr. 1915/1956) in challenge of a contradictory derivation (Abstr. 6330/1954)

both from the approach of conservation of energy. The crux of the situation is summarized by the author in the two questions: (1) what is the instantaneous power transmitted by a piston to air on one side of it? and (2) what is the change of internal energy of a given mass in a small adiabatic change of pressure from P to (P + ΔP)?
A.B.Wood

534.23 : 532.74

ULTRASONIC ABSORPTION IN ASSOCIATED LIQUIDS.
See Abstr. 5920

534.222.2

5940. SHOCK SPHERE — AN APPARATUS FOR GENERATING SPHERICAL FLOWS. I.I.Glass and J.G.Hall.
J. appl. Phys., Vol. 28, No. 4, 424-5 (April, 1957).

Some experimental results are presented of the flow generated by the explosion of a sphere of high-pressure gas. Glass spheres of 1, 2, and 5 in. dia. containing air, He, or SF_6 at overpressures up to 21 atm were used to produce a spherical analogue of the shock tube. The results show that the shock sphere may be applied to the study of explosions, implosions and spherical wave interaction under controlled and known initial conditions. A.

534.232 : 621.395.614

5941. COUPLING FACTORS AND THE ELECTROMECHANICAL EFFICIENCY OF PIEZOELECTRIC MATERIALS. Y.Le Corre.
J. Phys. Radium, Vol. 18, No. 1, 51-8 (Jan., 1957). In French.

The definition of the different electromechanical coupling factors is considered and it is shown that the square of the coupling factors, defined in a certain manner, can be regarded as an electromechanical efficiency, an important quantity in considering acoustic transmitters and receivers. H.J.H.Starks

534.232

5942. SOUND RADIATORS WITH TRAVELLING WAVES.
S.N.Rževkin.
Vestnik Moskov. Univ., Vol. 9, No. 8, 3-17 (1954). In Russian.

The velocity potential of a sound wave excited by a rotating body is examined, and the radiation field is discussed. This is done for a sphere, with ridges along certain meridians, and for a cylindrical radiator. The similarity between the latter and a plane surface wave radiator using a periodic surface structure is discussed. Some experimental results are given.
Mathematical Reviews

534.372

5943. THERMOELASTIC DAMPING AT THE BOUNDARY BETWEEN DISSIMILAR SOLIDS. M.Lessen.
J. appl. Phys., Vol. 28, No. 3, 364-6 (March, 1957).

The problem of thermoelastic damping at the boundary between dissimilar solids is investigated for the case of small, sinusoidal, longitudinal disturbances of long-wavelength propagating normally through the interface. The relevant equations are derived from thermodynamic considerations, and it is found that the mechanical energy absorption per unit time is proportional to the square root of the disturbance frequency. A.

534.39

5944. THE FORCE ON OBSTACLES IN A SOUND FIELD.
A.Johansen, H.Olsen and H.Wergeland.
K. Norske Vidensk. Selsk. Forhandl., Vol. 28, No. 1, 16-20 (1955).

A general theoretical expression for the force on a rigid sphere in an infinite plane wave field is derived from the momentum entering the surface per second. H.D.Parbrook

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

OPTICS. RADIATION. SPECTRA 535

535.14

5945. COHERENCE AND THE QUANTUM. R.H.Dicke.
J. Opt. Soc. Amer., Vol. 47, No. 6, 527 (June, 1957).

Several quantum effects associated with coherence are discussed. The conditions under which a gas will spontaneously radiate coherently are described. Possibilities are examined for the excitation of optical "superradiant" states of gas. Comparisons are made with microwave spectroscopy. There is a discussion of the connection between coherence and photon correlation effects. A.

535.222

5946. SOME RECENT DETERMINATIONS OF THE VELOCITY OF LIGHT. II. J.F.Mulligan and D.F.McDonald.
Amer. J. Phys., Vol. 25, No. 3, 180-92 (March, 1957).

For previous part see Abstr. 3418 (1952). Four methods developed during the past five years for the determination of the velocity of light in vacuo are reviewed. These include coincidence-counter determinations of gamma-ray velocities, band-spectra methods, Froome's microwave interferometer, and Florman's radiofrequency interferometer. The results of recent repetitions of Bergstrand's geodimeter measurement of c are also summarized. The best measurements by a variety of techniques yield a weighted average of 299 792.8 km/sec for c, with a probable error of ±0.2 km/sec. A reasonable limit of error of ±0.6 km/sec is recommended. Some reasons for the low values of c obtained previously by optical techniques are discussed. A.

535.231.2

5947. ON THE AVERAGE VOLUME PER PHOTON IN BLACK-BODY RADIATION. C.W.Sherwin.
Amer. J. Phys., Vol. 25, No. 2, 118-19 (Feb., 1957).

Discusses justification of assumption made by Shanks (Abstr. 4285/1956) in deducing Wien displacement and Stefan–Boltzmann laws. F.E.Hoare

535.231.2 : 535.14

5948. CONCENTRATION AND SIZE OF PHOTONS FROM PARTICLE INTERPRETATION OF BLACKBODY RADIATION. S.J.Magram.
Amer. J. Phys., Vol. 25, No. 5, 283-4 (May, 1957).

In the Planck radiation law the expression for energy density between λ and $\lambda + d\lambda$ may be divided by hc/λ to give an expression for the number of photons per unit volume as a function of λ. It is shown that $N = 20.30\ cm^{-3}\,deg^{-3}\,T^3$, where N is the number of photons per cm^3. The expressions $\lambda_n T = 0.3669$ cm deg and $\lambda_a T = 0.5326$ cm deg are derived, where λ_n is the wavelength at which the number of photons per unit volume between λ and $\lambda + d\lambda$ is a maximum and λ_a is the wavelength associated with the photon of average energy. The average energy per photon is $E_{Av} = 2.701\ kT$. A.

535.247.4

5949. THE DETERMINATION OF DENSITY CONTOURS BY ELECTRON-OPTICAL METHODS. A.Lohmann.
Optik, Vol. 14, No. 4, 178-82 (April, 1957). In German.

The determination of density contours is of importance in many applications of interference, etc. Photographic photometry can be used but is often laborious. Using a television system, having a similar characteristic curve to photographic emulsions, the optical image can be readily explored. Moreover, the electrical signal can be differentiated to display the contour lines directly upon the display tube. The method is discussed in terms of information theory.
R.W.Fish

535.3

5950. FIBER OPTICS. I. OPTICAL PROPERTIES OF CERTAIN DIELECTRIC CYLINDERS. N.S.Kapany.
J. Opt. Soc. Amer., Vol. 47, No. 5, 413-22 (May, 1957).

Various novel applications of transparent fibres call for their high light conductivity and appropriate radiation properties. Different factors affecting the optical properties of dielectric cylinders are discussed and methods for making precise measurements on them have been devised. The geometrical optical properties of cylindrical and conical channels are dealt with. Microinterferometric technique is employed for the continuous testing of cylindricity and variation in diameter of long lengths of fibres. The surface structure of drawn glass fibre is studied using electron microscopy. Absolute refractive index and any inhomogeneties in fibres are measured using multiple beam interference and the fringes of equal chromatic order. It is seen that there exists a difference in refractive index of the glass fibre and the bulk material. The birefringence in various fibres is also measured on a polarizing microscope. Light transmission of certain glass fibres is measured and the optical properties of bent fibres are studied. The modification of radiation patterns of fibres curved on circular arcs is investigated and photometric measurements on them are made. A.

535.3

5951. FIBER OPTICS. II. IMAGE TRANSFER ON STATIC AND DYNAMIC SCANNING WITH FIBER BUNDLES.
N.S.Kapany, J.A.Eyer and R.E.Keim.
J. Opt. Soc. Amer., Vol. 47, No. 5, 423-7 (May, 1957).

For Pt I, see preceding abstract. The image transfer through a

stationary bundle of fibres can be thought of as a static sampling of the illuminance of the image at the entrance end of the bundle by each fibre element. This discrete sampling limits the band width of signals which can be transmitted. Also, the ends of the component fibres form an obtrusive pattern in the received image. However, the resolving power of the system is improved materially by random dynamic scanning with the fibre bundle. Also, the individual fibre ends are thus blurred out and the obtrusive pattern formed by them is destroyed. Because each fibre integrates the flux falling upon its entrance aperture, the entire picture format scanned dynamically is reproduced at the frequency response characteristic of a uniform disk whose diameter is equal to that of the component fibres. An experimental set-up for the detailed investigations of the effect of dynamic scanning with a fibre bundle is described. A gain of 100% in resolution by this method is illustrated by photographs and densitometer traces of various test objects which have been scanned both statically and dynamically. A.

535.31

5952. GEOMETRICAL OPTICS IN MOVING DISPERSIVE MEDIA. J.L.Synge.
Commun. Dublin. Inst. Advanced Stud. A., No. 12, 63 pp. (1956).

In this paper Hamilton's method in geometrical optics, suitably generalized, is used as a basis for relativistic geometrical optics in moving dispersive media. As for the physical validity of the theory here developed, no new assumption is added to existing geometrical optics in the case of media which move without acceleration; all the theory does is to replace by a single systematized plan the known method of reducing each medium to rest in turn by a Lorentz transformation. The results for accelerated media, on the other hand, must be regarded as tentative; the assumption is made that, in the local rest frame of the medium, phase velocity is given by the refractive index for the medium when completely at rest. A.

535.313.2 : 551.521.1 : 536.3

ANALYSIS OF LARGE APERTURE PARABOLIC MIRRORS FOR SOLAR SURFACES. See Abstr. 5267

535.315

5953. THE DISPERSION AND RESOLUTION OF PRISMATIC SPECTRAL APPARATUS WITH RECTANGULAR APERTURES. K.D.Mielenz.
Optik, Vol. 14, No. 3, 103-18 (March, 1957). In German.

The geometry of typical prism arrangements is given and the resolving power of each type is calculated. The effect of chromatic aberration of the collimator and camera is considered, and the influence of camera magnification on resolving power calculated. R.W.Fish

535.317.1

5954. SATISFYING "THICK LENS" EXPERIMENT. T.H.Wood.
Amer. J. Phys., Vol. 25, No. 5, 281-2 (May, 1957).

An elementary experiment is described in which an object–image relationship for a thick lens is determined both by experiment and by calculations involving easily determined lens parameters. The two methods have over-all errors of less than 6% and agree quite well.

535.317.1

5955. EFFECTS OF SMALL ABERRATIONS ON THE IMAGES OF PARTIALLY COHERENT OBJECTS. W.H.Steel.
J. Opt. Soc. Amer., Vol. 47, No. 5, 405-13 (May, 1957).

The effects of small aberrations on the contrast transfer factors for periodic line structures and on the central contrast of a line image are calculated for partially coherent illumination of the object. The approximation used is sufficiently accurate for deriving aberration tolerances. A.

535.317.1

5956. MODERN TRENDS IN THE EVALUATION OF OPTICAL IMAGES. G.Toraldo di Francia.
J. Opt. Soc. Amer., Vol. 47, No. 6, 507 (June, 1957).

535.317.1

5957. THE PROBLEM OF CRITICAL APERTURE. J.Focke.
Optik, Vol. 14, No. 2, 92-4 (Feb., 1957). In German.

Photographic lenses have a critical aperture at which the definition is a maximum. A criterion of definition based upon the maximum intensity in the diffraction image of a point source is used. Calculations of definition for lenses having a range of spherical aberration coefficients show that the maximum aperture has highest definition for small amounts of aberration, while there are maxima and minima in the definition curve for large amounts of aberration. R.W.Fish

535.317.1

5958. FOURIER IMAGES. I. THE POINT SOURCE. J.M.Cowley and A.F.Moodie.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 486-96 (May, 1957).

The problem of designing a light or electron-optical system specifically for the imaging of periodic objects, such as real crystals, is discussed. A qualitative appeal to communication theory suggests that it should be possible to devise systems of higher efficiency than the conventional microscope by using the a priori knowledge of periodicity. The possibility of deforming the incident wavefront in such a way that the periodic object acts as its own imaging system is considered and a formalism is set up. The particular case of the spherical wavefront is then examined in detail and it is predicted that a new type of image should be formed on certain planes. Since this image is in many ways analogous to the Fourier projection of crystallography, and since it can only be formed by periodic objects, it is named the Fourier image. Fourier images produced experimentally with light optics are presented and shown to be in agreement with theoretical predictions. Patterns on planes other than Fourier image planes are described briefly, but detailed treatment is deferred until Pt II. The possibility of application to the imaging of crystal lattices by electron optics is discussed, but a quantitative treatment of the crucial problems of finite source size and coherence are deferred until Pt III. A.

535.317.1

5959. FOURIER IMAGES. II. THE OUT-OF-FOCUS PATTERNS. J.M.Cowley and A.F.Moodie.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 497-504 (May, 1957).

The theoretical and experimental investigation of Fourier images described in Pt I is extended to the patterns on planes other than focal planes. The theory is developed from a new statement of the diffraction equations correct to the Fresnel approximations, and experimentally observed patterns are shown to be in good agreement with the results of the theory. It is concluded that, at least within the angular range of the experiments, some fifteen degrees, the Fresnel approximation gives an adequate description of the phenomenon. A.

535.317.1

5960. FOURIER IMAGES. III. FINITE SOURCES. J.M.Cowley and A.F.Moodie.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 505-13 (May, 1957).

The theoretical and experimental investigation of Fourier images, described in Pts I and II, is extended to the case of finite sources. The Fourier images produced by a pair of point sources, a rectangular source and a Gaussian source are considered in detail. The dependence of focus on source dimensions for the first two of these cases is confirmed experimentally with light optics. From the results obtained for these idealized sources, the contrast and resolution of Fourier images from experimentally realizable sources is deduced. The possibility is considered of an improvement in resolution in the electron microscopy of thin crystals when the first stages of magnification are performed by forming magnified Fourier images. It is shown that the resolution that can be attained depends on the sharpness with which the boundaries of the source are defined. In particular, if the effective source is formed by using electron lenses to demagnify a larger source, the resolution may be improved by a factor of $2^{-\frac{1}{2}}$. A.

535.317.1

5961. STUDY OF A METHOD OF FILTERING OPTICAL IMAGES. P.Croce.
Rev. Opt., Vol. 35, No. 11, 569-89 (Nov.); No. 12, 642-56 (Dec., 1956). In French.

After a review of the theory of image formation by the Fourier analysis method, an arrangement is described whereby any required linear transformation may be carried out on an image recorded on a photographic film. The conditions for minimum distortion are derived and the equipment needed is described. Methods of making the filters are given and sample photographs are shown in which increased contrast and sharpness have resulted from the use of appropriate filters. R.W.Fish

535.317.1

5962. THE TRANSMISSION OF SPATIAL FREQUENCIES BY OPTICAL INSTRUMENTS. A.Maréchal.
Rev. Opt., Vol. 35, No. 11, 603-7 (Nov., 1956). In French.

Analogies are drawn between the formation of optical images with incoherent light and radioastronomy. A review is given of the theory of image formation and the concept of an optical instrument as a filter of spatial frequencies. R.W.Fish

535.317.1

5963. INFLUENCE OF CHROMATISM UPON DIFFRACTION IMAGES. P.Lacomme.
Rev. Opt., Vol. 36, No. 1, 1-19 (Jan., 1957). In French.

The treatment of secondary spectrum in terms of partial dispersions is shown to be correct only for thin lenses. Some unusual systems made from ordinary glasses are discussed but are shown to be of little practical value. A discussion of the chromatic differences of the usual monochromatic aberrations is given. Maréchal's mean-square method of calculating image quality is used to determine the image quality of an image in white light. R.W.Fish

535.317.1

5964. THE INFLUENCE OF CHROMATISM ON DIFFRACTION IMAGES. P.Lacomme.
Rev. Opt., Vol. 36, No. 2, 71-87 (Feb., 1957). In French.

The results of the preceding abstract are applied to microscope images with artificial light and either visual or photographic recording. The effect of chromatic differences on systems, such as telescopes and photographic objectives, in which large amounts of abberation are present, is considered theoretically and some experimental verification of the results is given. R.W.Fish

535.317.5

5965. SPHERICAL ABERRATION AND THE INFORMATION CONTENT OF OPTICAL IMAGES. G.Black and E.H.Linfoot.
Proc. Roy. Soc. A, Vol. 239, 522-40 (April 9, 1957).

The main purposes of the paper is to investigate the effect of spherical aberration on the information content of low-contrast photographic images with specified spread and noise characteristics. An outline is given of the basic ideas and the relevant formalism. The response functions of monochromats with spherical aberration and defocusing are considered, and their computed values in selected special cases are displayed. A digression is made in order to discuss, with the help of these values, a point of topical interest, namely, the variation of best focus with the line frequency of a sinusoidal test object. The notion of the equivalent receiving surface of a low-contrast photographic process is introduced and two equivalent receiving surfaces are defined, with the help of some experimental results of Higgins and Jones (1952), which corresponds to model photographic processes used with low-contrast objects. The mean information density in the images of an aberration-free monochromat is calculated for two model emulsions, at selected noise levels, over a range of focal settings. In both models, the correctly focused images of a random object set are found to contain about one bit per Airy disk when the signal-to-noise ratio is 100 and the effect of defocusing are similar in the two cases. The effect of spherical aberration on information density at different focal settings is then examined in the second model. It appears that, for amounts of fourth-power aberration up to two fringes, the informationally best focus is approximately midway between paraxial and marginal foci, and that the acceptance of a 20% drop in information content corresponds to a focal tolerance of approximately $\pm\frac{1}{2}$ fringe. A.

535.317.6

5966. THE ABERRATION PERMISSIBLE IN OPTICAL SYSTEMS. H.H.Hopkins.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 449-70 (May, 1957).

The tolerance on aberration is made subject to the criterion that the response of the optical system for a given frequency shall not be less than 0.8 of the response of the same system in the absence of aberration. In this way the tolerance on aberration is related to the number of lines to be resolved with good contrast. The method is applied to defect of focus, spherical aberration, coma and astigmatism. The best form of correction and focal plane according to this criterion are determined by the same method. The results are expressed by approximate formulae for the lower spatial frequencies which are those of importance in other than very highly corrected systems. A.

535.323

5967. ANOMALOUS DISPERSION OF CuI AT 77°K. S.Nikitine and R.Reiss.
J. Phys. Radium, Vol. 18, No. 1, 74-5 (Jan., 1957). In French.

Layers 0.4-2 μ thick were obtained by vacuum sublimation. They were observed by reflected light at 77°K, and, from the form of the interference fringes, the refractive index was determined for wavelengths between 3900 and 4300 A. Anomalous dispersion is found at 4050 A. C.Hilsum

535.323

5968. ON THE DISPERSION OF THALLIUM IODIDE–BROMIDE (KRS 5). W.Leo.
Optik, Vol. 14, No. 4, 148-50 (April, 1957).

A numerical approximation formula is given which expresses the refractive index of KRS 5 as a function of wavelength with sufficient accuracy. It is further shown that in the long-wave region (from $\lambda = 8\ \mu$ onwards) the dispersion is practically proportional to the wavelength. A.

535.325.08 : 535.345.08 : 531.717.1

5969. THE MEASUREMENT OF THE THICKNESS AND THE OPTICAL CONSTANTS OF VERY THIN METAL FILMS. H.Wolter.
Z. Phys., Vol. 147, No. 1, 1-23 (1957). In German.

For a thin metal film on a glass substrate one may calculate the reflection from each side and the transmission in terms of n, the refractive index, k, the absorption coefficient, and d, the thickness. A phase change is associated with each of these intensities, and at normal incidence the six quantities depend, to a high accuracy, only on the product ndk. Measurement of any two of the quantities gives the other four, as they are interdependent. The errors involved are discussed and tabulated. At non-normal incidence, with the electric vector parallel to the plane of the film, similar considerations apply. Using light at glancing incidence with the magnetic vector parallel to the plane of the film, a different combination of n, k and d can be measured. C.Hilsum

535.327 : 539.89

5970. OPTICAL AND VOLUMETRIC RELAXATION EFFECTS IN GLASS FOLLOWING REMOVAL OF HIGH HYDROSTATIC PRESSURES. C.Weir, S.Spinner, I.Malitson and W.Rodney.
J. Res. Nat. Bur. Stand., Vol. 58, No. 4, 189-94 (April, 1957).

Optical and volumetric relaxation in glass were studied after compressing specimens 4 hours at 9000 atmospheres and 21°C. Following release of pressure the refractive index was higher than the original value and decreased with time, recovering its initial value within 12 hours. Optical-relaxation curves for lead and borosilicate glasses were complex, the detailed behaviour depending on composition and thermal history. No corresponding effects were observed in fused silica after exposure to even higher pressures. Volumetric changes associated with index changes were determined interferometrically and found to be less than corresponding changes known to accompany annealing. Possible implications of the results are discussed. A.

535.33.03

5971. SPECTRA PRODUCED BY SHOCK WAVES, FLAMES AND DETONATIONS. A.R.Fairbairn and A.G.Gaydon.
Proc. Roy. Soc. A, Vol. 239, 464-75 (April 9, 1957).

Emission spectra excited in various gases, including fuel and fuel–argon mixtures, by strong shock waves from a bursting diaphragm are compared with those given by flames and by spark-ignited and shock-ignited detonations. Shocks through hydrocarbon or hydrocarbon–argon mixtures, without oxygen, give carbon formation and C_2 emission but not CH. Formaldehyde, ether, alcohols, ethyl nitrate, carbon tetrachloride and chloroform have also been studied. Carbon monoxide–argon mixtures give strong C_2 but no CO bands; hydrogen or oxygen only slightly quench this C_2, but mixed hydrogen and oxygen quench it strongly. Reactions involving C_2 and and CH are discussed. In detonations, OH is very strong, and C_2 and CH are weak compared with burner flames. Time records, using a photomultiplier and oscillograph, indicate that C_2 emission comes from the reaction zone of the detonation, but OH and the continuous spectrum are emitted mainly by the hot gases behind the front. The relation of the results to the propagation mechanism is briefly discussed. Shock-excited spectra resemble those produced by flames rather than those from discharge tubes, and this appears to be a promising technique for studying fundamental processes in flames. A.

535.33.03

5972. STUDY OF SOME SOURCES USED FOR MEASUREMENTS IN THE INFRARED FROM 1 TO 10 MICRONS. M.Axelrad.
Rev. Opt., Vol. 35, No. 8-9, 437-41 (Aug.-Sept., 1956). In French.

The intensities of several sources are measured by comparison with a platinum cavity at 1435°K. The results are tabulated as radiated watts per cm² per steradian per micron against wavelength. The Nernst filament has the highest emission at all wavelengths. G.F.Lothian

535.33.07

5973. REFERENCE WAVELENGTHS FOR CALIBRATING PRISM SPECTROMETERS. E.K.Plyler, L.R.Blaine and M.Nowak.
J. Res. Nat. Bur. Stand., Vol. 58, No. 4, 195-200 (April, 1957).

Standard wavelengths for calibrating infrared-prism instruments have been measured from the absorption bands of polystyrene, 1,2,4-trichlorobenzene, and toluene. Several bands of didymium glass have been calibrated for the near-infrared region, and 27 rotational lines of the 3.3 μ band of methane have been measured. The wavelengths fall in the region from 0.6 to 24 μ, but the greatest number are in the 3 to 6 μ region. A few bands of several other materials are also given in the wavelength tables, and 11 figures of the spectra marked with the calibrating values are included for identification. A.

535.331 : 539.153

5974. ON THE COHERENCE OF THE PHENOMENON OF MULTIPLE SCATTERING OF LIGHT IN OPTICAL RESONANCE. M.A.Guiochon, J.E.Blamont and J.Brossel.
J. Phys. Radium, Vol. 18, No. 2, 99-108 (Feb., 1957). In French.

From optical experiments on the 2537 A line of natural Hg, Hg^{198}, and Hg^{202}, in the temperature range $-35^{\circ}C$ $+20^{\circ}C$ it was shown that depolarization and lifetime phenomena are better explained as a multiple scattering effect rather than one involving Lorentz-type collisions. Formulae are given for calculation of light intensity in optical transitions induced by radiofrequency radiation. Measurements on the parameter, T_e showed that this was a function of the source and cell dimensions. Unlike Brossel and Bitter (Abstr. 5993/1952) the authors do not identify T_e with the lifetime of the excited state. L.Bovey

535.331

5975. THE ATOMIC SPECTRUM OF PLUTONIUM. A.R.Striganov and L.A.Korostileva.
Optika i Spektrosk., Vol. 1, No. 8, 957-64 (1956). In Russian.

The wavelengths of 966 lines taken on prism instruments in the region 2500-7000 A, from plutonium excited by an a.c. arc in air given with an accuracy of 0.05-0.1 A. These have been compared with those published and,on the basis of relative intensities given in these works, assignment to Pu I and Pu II made for 422 lines. A list of "sensitive" lines is included. L.Bovey

535.331

5976. ISOTOPE SHIFT IN THE SPECTRUM OF INDIUM I. D.A.Jackson.
Phys. Rev., Vol. 105, No. 6, 1925 (March 15, 1957).

Earlier work (Abstr. 3613/1956) is corrected because of different figures for the mass spectrograph isotope analysis of the enriched indium. Revised figures for the isotope shifts (mk) are 8.7, 8.9, 7.5, 7.5, 7.0 for the lines 4511, 4101, 3256, 3039, 2710 A respectively. L.Bovey

535.331

5977. THE ATOMIC SPECTRUM OF AMERICIUM. M.H.Oganov, A.R.Striganov and Y.P.Sobolev.
Optika i Spektrosk., Vol. 1, No. 8, 965-71 (1956). In Russian.

The wavelengths of 1044 lines, taken on both prism and grating instruments in the region 2500-7700 A from americium excited by an a.c. arc in air are given with an accuracy of 0.05-0.1 A. Some of these are assigned to the I or II spectra. A list of "sensitive" lines is included. L.Bovey

535.333

5978. EMISSION BAND SPECTRA OF NITROGEN. KAPLAN'S FIRST AND SECOND SYSTEMS. A.Lofthus and R.S.Mulliken.
J. chem. Phys., Vol. 26, No. 5, 1010-17 (May, 1957).

Seven bands of Kaplan's first system and eleven bands of Kaplan's second system have been photographed under high resolution. The two systems are definitely $y\,^1\Pi - a'\,^1\Sigma$ and $y\,^1\Pi - w\,^1\Delta$. It is very probable that they are $y\,^1\Pi_g$-$a'\,^1\Sigma_u^-$ and $y\,^1\Pi_g$-$w\,^1\Delta_u$ and that the two lower states belong, along with $A\,^3\Sigma_u^+$ and $b'\,^1\Sigma_u^+$, to the N_2 configuration $\ldots \pi_u{}^3\sigma_g{}^2\pi g$. A clear breaking-off of the branches coming from the Π^+ levels of the $y\,^1\Pi_g$ state above $v' = 0$, $J' = 10$ was observed. This is interpreted as an allowed predissociation by a $^1\Sigma_g^+$ state dissociating to two ^2D atoms. Consequently lower limits probably close to the term values for the x, y, w, and a' states could be determined; this locates the a' and w states respectively probably about 2.2 and 2.7 eV above state A, in good agreement with theoretical expectations. Perturbation of the remaining Π^- levels was also observed. Rotational and vibrational constants and term values of the various states are presented. The transions $a' \leftrightarrow a$ and $w \leftrightarrow a$ should give rise to bands in the (mostly far) infrared. It is noted that the constants of both the x and y states are close to those of the N_2^+ state $\ldots \pi_u{}^3\sigma_g{}^2$, and it is proposed that $x\,^1\Sigma_g^-$ and $y\,^1\Pi_g$ are respectively derived from the latter by the addition of an electron in a $3p\pi_u$ and a σ_u ($4p\sigma_u$?) Rydberg orbital. It is then proposed that the $D\,^3\Sigma_u^+$ and $p'\,^1\Sigma_u^+$ states of N_2, whose constants are close to those of the ground state $\ldots \pi_u{}^4\sigma_g$ of N_2^+, are derived from the latter by addition of an electron in the same σ_u Rydberg orbital as in the y state. The states p' and e are the first two members of Worley's first Rydberg series. A.

535.34

5979. METHOD OF OBTAINING DERIVATIVE SPECTRA. J.P.Pemsler.
Rev. sci. Instrum., Vol. 28, No. 4, 274-5 (April, 1957).

The first derivative with respect to wavelength of the transmission curve has been used to detect overlapping spectral bands. The Perkin–Elmer ratio recording spectrophotometer may be easily adapted to record directly the derivative spectrum throughout the ultraviolet, visible, and infrared regions. A.

535.34.07

5980. EQUIPMENT FOR HIGH PRESSURE OPTICAL AND SPECTROSCOPIC STUDIES. E.Fishman and H.G.Drickamer.
Analyt. Chem., Vol. 28, No. 5, 804-5 (May, 1956).

Equipment has been developed for making optical and spectroscopic studies in liquids at pressures up to 12 000 atm. A combination intensifier and bomb for spectroscopic measurements is described, as well as a source assembly particularly suited for use with a Perkin–Elmer single-beam spectrometer. The use of synthetic sapphire windows permits measurements to be made in the wave-length range from 0.2 to 5.0 microns. Experiments are now being undertaken to develop windows which will permit extension of the wavelength range. With this equipment it is possible to study the effect of pressure in all phases of molecular spectroscopy. By suitable modification, it is possible to measure the effects of pressure on the refractive index and on light scattering from polymer solutions, as well as related optical effects. A.

535.34.07

5981. INFRARED GRATING SPECTROPHOTOMETER. J.U.White, N.L.Alpert, A.G.DeBell and R.M.Chapman.
J. Opt. Soc. Amer., Vol. 47, No. 5, 358-67 (May, 1957).

An instrument is described that makes convenient the use of high resolution in infrared spectroscopy. While the actual resolution is energy limited, the use of mosaics of gratings up to $10\frac{1}{2} \times 14\frac{1}{2}$ inches in area makes it possible to resolve close to the theoretical for the largest gratings obtainable. The spectra are recorded directly as graphs of transmittance v. wavelength on scales that are accurate enough to eliminate the need for point by point recalculation. An internal mercury arc gives absolute checks on the accuracy of the sine bar mechanism that generates the wavelength scale. The transmittance scale is based on the optical null double beam principle described by Wright and Herscher (Abstr. 1803/1947) with the added freedom from scattered light that results from a double monochromator. The spectrometer may be adapted to a wide range of problems by changing detectors, sources, gratings, prisms, and windows. It is usable from the near ultraviolet to as far into the infrared as available prism materials and gratings permit. The grating may be used in any order with either single or double pass of the grating monochromator. The slit and prism drive mechanism may be automatically and continuously synchronized with any of these orders and with any of the different interchangeable components. The range of operating conditions is very large. The instrument may be operated as a double beam null indicator or as a single beam energy recording instrument. Its scanning time may be adjusted from about 10 minutes to 3 months for the full range of grating angles. Response time may be varied from one second to 100 seconds full scale. The slits may be varied automatically according to any preselected programme. A.

535.34.07

5982. SIMPLE LOGARITHMIC RATIO-RECORDING SPECTROPHOTOMETER ATTACHMENT. P.Hariharan and M.S.Bhalla.
J. Opt. Soc. Amer., Vol. 47, No. 5, 378-81 (May, 1957).

A double-beam system is described which uses a single photomultiplier tube operated in a logarithmic difference circuit to give direct readings of log transmittance. The circuit compensates for changes in the incident energy as well as variations in the spectral sensitivity of the photocathode, over a very wide range. The attachment can be used to convert any good monochromator into a recording spectrophotometer, and permits measurements of spectral densities as high as 3 with an accuracy better than 0.02 density unit. A.

535.34.07

5983. DESCRIPTION OF AN INFRARED SPECTROMETER WITH PRISMS AND GRATINGS ADAPTED TO THE STUDY OF CRYSTALS. A.M.Vergnoux and C.Deloupy.
Rev. Opt., Vol. 36, No. 1, 20-31 (Jan., 1957). In French.

Describes the construction of a Wadsworth mounting with 60° prism with the possibility of using a Walsh triple-pass arrangement. The prism may be replaced by a plane echelette grating with about 80 lines per mm, orders being separated by a 15° prism. The instrument is recording and the mechanism for scanning the spectrum and for interchanging crystal specimens is described.
G.F.Lothian

535.343

5984. RELATIVISTIC RADIATIVE TRANSITIONS. I.P.Grant.
Phys. Rev., Vol. 106, No. 4, 754 (May 15, 1957).

The relativistic electric dipole oscillator strengths at the spectral line-absorption series limit for K-electrons in lead have been recomputed, and discrepancies between published values resolved.
A.

535.343 : 538.615 : 548.7

5985. THE LINEAR AND QUADRATIC ZEEMAN EFFECT AND THE DIAMAGNETISM OF THE CUPROUS OXIDE CRYSTAL EXCITON. E.F.Gross and B.P.Zakhartchenia.
J. Phys. Radium, Vol. 18, No. 1, 68-72 (Jan., 1957). In French.

The effect of a high magnetic field (30 000 Oe) at a temperature of 1.3°K on the absorption lines arising from excitons in the Cu_2O crystal was studied on a high dispersion (1.5 A/mm) spectrograph. The spectral splitting displacement and polarization data were obtained for many of the members of two series of lines. From the diamagnetic displacement, the exciton radius was calculated to be 200 A.
L.Bovey

535.343 : 539.13

5986. EXCITON SHAPE DEPENDENCE AND DAVYDOV SPLITTING IN AROMATIC CRYSTALS. D.P.Craig and J.R.Walsh.
J. chem. Phys., Vol. 25, No. 3, 588-9 (Sept., 1956).

Theoretical. Further calculations using non-spherical shapes for the region over which intermolecular interactions are summed in anthracene and naphthalene show that the spherical region gives best agreement with experiment, tending to refute the criticisms by Fox and Yatsiv (Abstr. 5298/1956) of the methods of Abstr. 3616 (1956), and confirming the assignment of the 2500 A system in anthracene as long-axis polarized.
J.Hawgood

535.343 : 539.132

5987. REMARKS ON THE THEORY OF ABSORPTION SPECTRA OF SYMMETRICAL CYANINE DYES AND POLYENES. S.Olszewski.
J. chem. Phys., Vol. 26, No. 5, 1205-7 (May, 1957).

The AS FEMO method was applied in order to calculate the absorption maxima in the spectrum of symmetrical cyanine dyes and polyenes. An improvement of the theoretical λ_{max} values for cyanines can be obtained by introducing the "resonance" barrier in the FE model. The height of this barrier is determined by the stabilization energies of the cyanine nuclei.
A.

535.343

5988. DISCUSSION OF THE ABSORPTION SPECTRA OF H_2O AND D_2O IN THE FAR ULTRAVIOLET. A.Johannin-Gilles, N.Astoin and B.Vodar.
Cahiers de Phys., No. 71-72, 49-53 (July-Aug., 1956). In French.

The spectrum of water (2000-160A) and semiquantitative absorption coefficients are presented. The absorption curves of H_2O and D_2O are similar and the coefficients are of the same order of magnitude.
G.Allen

535.343

5989. SPECTRA OF THE ALKALI HALIDES. III. ELECTRONIC SPECTRA OF LITHIUM CHLORIDE, LITHIUM BROMIDE, AND LITHIUM IODIDE. R.S.Berry and W.Klemperer.
J. chem. Phys., Vol. 26, No. 4, 724-6 (April, 1957).

For Pt I see Abstr. 4151 (1957). The ultraviolet absorption spectra of the molecules LiCl, LiBr, and LiI have been observed in the quartz region. These spectra, which appear as continua with associated diffuse bands, have been interpreted as arising from excitations to two excited states of the molecules. The symmetries and potential curves for these states are discussed.
A.

535.343

5990. FUNDAMENTAL ABSORPTION EDGE OF DIAMOND. J.F.H.Custers and F.A.Raal.
Nature (London), Vol. 179, 268-9 (Feb. 2, 1957).

Spectral absorption measurements upon a number of thin sections (0.038-0.457 mm) of two diamond specimens are reported, and spectral variations with thickness are discussed with particular application to errors which may arise in classification of diamonds from their spectra without prior reference to the thickness of specimen employed. Specific absorption edges at 3320 and 2220 A are described.
R.W.Nicholls

535.343

5991. ULTRAVIOLET ABSORPTION SPECTRA OF PYRIDINE IN THE LIQUID AND SOLID STATES. S.B.Banerjee.
Indian J. Phys., Vol. 30, No. 9, 480-4 (Sept., 1956).

In the case of the liquid as well as the solid only one system of bands in the region 2400-2650 A has been observed corresponding to the bands due to $\pi \rightarrow \pi^*$ transition found in the case of the vapour. The 0,0 band is found to shift towards the longer wavelengths with the liquefaction of the vapour and also with the solidification of the liquid. The bands due to $n \rightarrow \pi^*$ transition lying in the region 2700 A - 2900 A observed in the case of the vapour by previous workers are absent in the spectra due to the liquid and the solid. These results have been interpreted by assuming that in the liquid and solid states pyridine molecules form associated groups through weak virtual bonds formed through the nitrogen atoms and the hydrogen atoms of neighbouring molecules, preventing thereby the $n \rightarrow \pi^*$ transition. It is pointed out that these results corroborate the assignment of the system in the long wavelength region to $n \rightarrow \pi^*$ transition in the case of the vapour.
A.

535.343

5992. THE ULTRAVIOLET ABSORPTION SPECTRA OF O-,M-,P- FLUOROBROMOBENZENES. S.L.N.G.Krishnamachari.
Indian J. Phys., Vol. 30, No. 9, 487-8 (Sept., 1956).

The frequencies of the 0,0 bands of the vapour are given. Vibration frequencies of ground and excited states are tabulated with the suggested assignments and compared with the Raman frequencies.
G.F.Lothian

535.343 : 539.132

5993. ULTRA-VIOLET BAND SYSTEMS OF HF^+ AND DF^+. J.W.C.Johns and R.F.Barrow.
Nature (London), Vol. 179, 374 (Feb. 16, 1957).

A number of bands have been assigned to a transition $B\,^2\Sigma^+ - A\,^2\Sigma^+$ in HF^+ and DF^+: rotational and vibrational constants are given. The lower state for HF^+ has $r_e = 1.076$ A, $\omega_e = 2977.6$ cm^{-1}, and appears to correlate with $H^+ + F(^3P)$, the upper with $H + F^+(^1D)$. If $A\,^2\Sigma^+$ is the ground state, then the ionization potential of HF is 16.88 eV. An expected state, $^2\Pi_i$, formed from $H + F^+(^3P)$ has not yet been found.
R.F.Barrow

535.343 : 535.37 : 548.7

5994. ABSORPTION AND LUMINESCENCE OF COLOUR CENTERS IN KCl AND NaCl. C.Z.van Doorn and Y.Haven.
Philips Res. Rep., Vol. 11, No. 6, 479-88 (Dec., 1956).

Crystals of KCl and NaCl, coloured additively and quenched from high temperature to liquid-nitrogen temperature, show the F-absorption band and when irradiated in this band an emission in the infrared. If kept for a short time at room temperature a new absorption band (M-band) develops and irradiation in this band gives rise to a new emission band. If an M-absorption band is present, this new emission band is also found when the crystal is irradiated in the F-band. An explanation for this is offered. After longer periods of ageing also R-bands develop; irradiation in the R-bands as well as in the F-band gives rise to a third emission band.
A.

535.343

5995. INFRARED SPECTRUM OF N_2O_4. R.G.Snyder and I.C.Hisatsune.
J. chem. Phys., Vol. 26, No. 4, 960 (April, 1957).

The infrared spectrum of gaseous, liquid and solid N_2O_4 in the region 5500-320 cm^{-1} confirms that N_2O_4 has the same planar configuration in liquid and gaseous states as has been previously shown in the solid state by X-ray diffraction.
R.C.Seymour

535.343 : 539.132

5996. INFRARED SPECTRUM OF $N^{15}O_2$ AND FORCE CONSTANT OF NO_2. R.E.Weston, Jr.
J. chem. Phys., Vol. 26, No. 5, 1248-51 (May, 1957).

The infrared spectrum of $N^{15}O_2$ has been investigated and the following frequencies were determined: $\nu_1(a_1) = 1312 \pm 3$ cm^{-1}, $\nu_2(a_1) = 739.7 \pm 0.5$ cm^{-1}, $\nu_3(b_1) = 1578 \pm 2$ cm^{-1}. From these and the frequencies for $N^{14}O_2$, the following force constants were obtained: $f_d = 10.4 \pm 0.5$, $f_{\alpha/d^2} = 1.29 \pm 0.08$, $f_{dd} = 1.45 \pm 0.50$, $f_{d\alpha/d} = 0.098 \pm 0.180$ (all in millidynes/A).
A.

535.343

5997. ABSOLUTE INTENSITIES OF THE 721 AND 742 cm^{-1} BANDS OF CO_2. H.J.Kostkowski and L.D.Kaplan.
J. chem. Phys., Vol. 26, No. 5, 1252-3 (May, 1957).

The absolute intensities of the $01^10 \rightarrow 10^00$ and $02^00 \rightarrow 11^10$ bands of CO_2 at 721 and 742 cm^{-1}, respectively, have been determined with a curve-of-growth method utilizing the Elsasser periodic line pattern and a slit function calculation. The resulting intensities were $S_{01^10 \rightarrow 10^00}^{329\ ^\circ K} = 7.5\ cm^{-2}\ atm^{-1}$ and $S_{02^00 \rightarrow 11^10}^{329\ ^\circ K} = 0.22\ cm^{-2}\ atm^{-1}$. In addition the intensity of the $03^10 \rightarrow 12^00$ band at 740 cm^{-1} was estimated to be $S_{03^10 \rightarrow 12^00}^{329\ ^\circ K} = 0.032\ cm^{-2}\ atm^{-1}$. A.

535.343

5998. VIBRATIONAL SPECTRA OF NORMAL AND ISOTOPICALLY LABELED BORIC ACID. R.R.Servoss and H.M.Clark.
J. chem. Phys., Vol. 26, No. 5, 1175-8 (May, 1957).

Infrared spectra over the NaCl and KBr spectral regions have been obtained for H_3BO_3, $H_3B^{10}O_3$, and D_3BO_3 as the solid contained in pressed plates of KBr. Raman spectra have been studied for solutions of boric acid in water, methanol, and methyl borate. Frequency assignments for the normal vibrations are given. A.

535.343

5999. VIBRATIONAL SPECTRA OF NORMAL AND B^{10}-LABELED METHYL BORATE. R.R.Servoss and H.M.Clark.
J. chem. Phys., Vol. 26, No. 5, 1179-84 (May, 1957).

Infrared spectra have been obtained for normal and isotopically labelled methyl borate, $B(OCH_3)_3$ and $B^{10}(OCH_3)_3$, in the liquid and vapour phases over the NaCl and KBr spectral regions. Raman spectra have been obtained for normal and B^{10}-labelled methyl borate in the liquid phase. The assignment of fundamental frequencies given is consistent with the C_{3h} point group. Normal vibrations for planar molecules of the MX_3 type are correlated graphically. A.

535.343

6000. INFLUENCE OF DISSOLVED SALTS ON THE INFRARED ABSORPTION SPECTRA OF ISOTOPIC VARIETIES OF WATER IN THE LIQUID STATE. M.Ceccaldi, C.Thro and E.Roth.
Cahiers de Phys., No. 73, 37-41 (Sept., 1956). In French.

The displacements of the infrared absorption bands of H_2O, HDO, and D_2O on solution of KCl, NaCl, NaF, and $CaCl_2$ are tabulated for various concentrations. G.I.W.Llewelyn

535.343

6001. VIBRATIONAL SPECTRA OF MOLECULES AND COMPLEX IONS IN CRYSTALS. IX. BORIC ACID.
D.F.Hornig and R.C.Plumb.
J. chem. Phys., Vol. 26, No. 3, 637-41 (March, 1957).

The infrared spectrum of boric acid was studied at 25° C and −195° C in the form of randomly oriented crystallites and as a single crystal section at 25° C. The spectrum can be interpreted as skeletal vibrations of $B(OH)_3$ molecules plus the hydrogen vibrations, which are those of the hexagonal O—H...O rings. The spectrum demonstrates that the symmetry about the B atoms is less than trigonal. There is no evidence of proton disorder. A.

535.343

6002. ROTATION-VIBRATION SPECTRA OF METHYL AMINE AND ITS DEUTERIUM DERIVATIVES. A.P.Gray and R.C.Lord.
J. chem. Phys., Vol. 26, No. 3, 690-705 (March, 1957).

Methyl amines, methyl amine-d_2, methyl-d_3 amine and methyl-d_5 amine-d_2 of high chemical and isotopic purity have been synthesized and their infrared spectra studied at both prism and grating resolution. The rotation-vibration band centres of methyl amine have been measured with improved accuracy over previous investigations and with the aid of the spectra of the deuterium analogues a vibrational assignment differing in some important respects from those hitherto suggested has been made. The grating spectra in some cases show irregularities in the rotational fine structure but none which can be associated with effects due to hindered internal rotation. Recent studies in the microwave region have shown that these effects should not be observed within the resolution limits of the grating spectrometers used in this work. However, the first overtone of the torsional frequency in methyl amine, methyl amine-d_2 and methyl-d_3 amine has been observed in a position consistent with calculations based on a barrier height of 690 cm^{-1}. The rotational structure of a number of unperturbed vibrational bands has been analysed in terms of equations applicable to an approximate symmetric top and rotational constants have been obtained in good agreement with values calculated from parameters obtained from microwave investigations. A.

535.343

6003. EFFECTS IN THE SOLID-STATE INFRARED SPECTRUM OF CYANURIC ACID. W.M.Padgett II, J.M.Talbert and W.F.Hamner.
J. chem. Phys., Vol. 26, No. 4, 959-60 (April, 1957).

The infrared spectrum of cyanuric acid obtained from a KBr, KCl or NaCl pressed disk, or of the acid reprecipitated from water in an oil mull between plates of alkali halides, differs from that obtained for thin films sublimed on NaCl or for crystalline cyanuric acid. These differences are due to interaction of the acid with alkali halides particularly in the presence of moisture. R.C.Seymour

535.343

6004. ν_3 BAND OF METHANE. H.C.Allen,Jr and E.K.Plyler.
J. chem. Phys., Vol. 26, No. 4, 972-3 (April, 1957).

The ν_3 band of CH_4 has been observed using a grating spectrometer (Abstr. 7174/1952) with a 15000 line/in. grating from 3123-3005 cm^{-1} and a 7500 line/in. grating below 2970 cm^{-1}. With the resolution obtained of 0.04 cm^{-1}, P-branch lines with ground state $J \geq 2$ and R-branch lines with ground state $J \geq 3$ have been split into numerous components. R.C.Seymour

535.343

6005. THE MICROWAVE SPECTRUM OF TlI AND $BiCl_3$ IN THE 3 cm AND 1.5 cm BAND. H.Happ.
Z. Phys., Vol. 147, No. 5, 567-72 (1957). In German.

A heated microwave Stark-effect absorption cell operating up to 400° C is described. Transitions of TlI are identified and lead to $r_e = 2.8136 \pm 0.0003$ A, $eqQ = -523 \pm 50$ Mc/s. For $BiCl_3$ $B_0 = 1497 \pm 5$ Mc/s. D.H.Whiffen

535.343 : 539.132

6006. SUBMILLIMETER WAVE SPECTROSCOPY: ROTATION-INVERSION TRANSITIONS IN ND_3. G.Erlandsson and W.Gordy.
Phys. Rev., Vol. 106, No. 3, 513-15 (May 1, 1957).

The $J = 0 \rightarrow 1$ rotational transition of $N^{14}D_3$ has been measured at a wavelength of 0.97 mm. This transition is split into two components by inversion doubling of the ground vibrational levels. The frequencies of the two components were found to be 306 735.0 Mc/s and 309 909.35 Mc/s. Their separation, 3174.4 Mc/s, is equivalent to the sum of the inversion frequencies of the upper and lower states. The relative intensities of the upper and lower frequency components were found to be about 10 to 1, in agreement with theory. The B_0 value, 154 162.7 Mc/s, is obtained from the arithmetic mean of the two components, with the infrared value, $D_J = 3.4$ Mc/s. The B_0 value is consistent with a bond length of 1.0144 A and a bond angle of 107°. Superimposed upon each of the inversion components is a triplet hyperfine structure caused by the N^{14} quadrupole moment. This structure was measured for the higher frequency component, and the value, $eQq = -4.20 \pm 0.15$ Mc/s, was obtained for the N^{14} coupling. A.

535.343

6007. SHIFT OF CENTER FREQUENCY OF AN AMMONIA INVERSION SPECTRUM.
I.Takahashi, T.Ogawa, M.Yamano and A.Hirai.
Phys. Rev., Vol. 106, No. 3, 606 (May 1, 1957).

Preliminary observations have been made of the frequency shifts observed for the (3,3) line of wet and dry ammonia as a function of time and pressure. Frequency decreases (for wet ammonia) and rises (for dry ammonia) by nearly 2 kc/s in the first hour, thereafter changing little. Frequency rises non-linearly (10 kc/s for wet ammonia and 4 kc/s for dry ammonia) with pressure over the range 0-10 μ. R.W.Nicholls

535.343

6008. FREQUENCY OF THE AMMONIA (3,3) LINE.
K.Matsuura, Y.Sugiura and G.M.Hatoyama.
Phys. Rev., Vol. 106, No. 3, 607 (May 1, 1957).

The frequency of the ammonia (3,3) line was found to be $23\,870\,129.31 \pm 0.05 \pm 0.10$ kc/s by use of an absorption method employing source modulation. The first error term denotes uncertainty in measurement and the second, uncertainty in the reference time standard. R.W.Nicholls

535.343

6009. SPECTRA OF SOME SYMMETRIC-TOP MOLECULES IN THE ONE TO FOUR MILLIMETER WAVE REGION.
C.A.Burrus and W.Gordy.
J. chem. Phys., Vol. 26, No. 2, 391-3 (Feb., 1957).

Rotational transitions of several symmetric-top molecules have been measured. The molecular rotational constants for the most abundant isotopic species are: $B_0 = 8545.87_7$ Mc/s, $D_J = 2.96_0$ kc/s, $D_{JK} = 162.9$ kc/s, for CH_3CCH; $B_0 = 10\,348.86_2$ Mc/s, $D_J = 11.3$ kc/s,

D_{JK} = −18.0$_6$ kc/s, for CF_3H; B_0 = 4 594.26$_2$ Mc/s, D_J = 1.02$_0$ kc/s, D_{JK} = 1.28$_4$ kc/s, for OPF_3; B_0 = 7208.04$_9$ Mc/s, D_J = 7.55$_6$ kc/s, D_{JK} = −12.4$_5$ kc/s, for $Si^{28}F_3H$; B_0 = 2945.52$_6$ Mc/s, D_J = 0.306$_5$ kc/s, D_{JK} = 5.81$_4$ kc/s, for CF_3CN. These constants were found to predict all observed lines within the accuracy of measurement ~±0.2 Mc/s. Higher-order stretching terms were too small to measure. A.

535.343 : 539.132

6010. MICROWAVE SPECTRUM AND BARRIER TO INTERNAL ROTATION IN CH_3BF_2. R.E.Naylor, Jr and E.B.Wilson, Jr.
J. chem. Phys., Vol. 26, No. 5, 1057-60 (May, 1957).

The microwave spectrum of CH_3BF_2 has been observed in the frequency range 12-33 kMc/s. The identifiable lines are explained in terms of a model consisting of a symmetric top (CH_3) rotating with respect to an asymmetric framework (BF_2) with the top axis coinciding with the (least) principal inertial axis of the molecule. The value of the barrier to internal rotation was determined to be 13.77 ± 0.03 cal. Three moments of inertia were also obtained from the analysis: A = 10 586.73 (BF_2 group only), B = 8329.01, C = 4650.52 Mc/s. These are insufficient to determine the molecular structure, but are consistent with the structure reported from electron diffraction. Stark effect measurements yield a dipole moment of 1.67 ± ± 0.02 D. A.

535.345

6011. CORRECTION FOR REFLECTION, ABSORPTION, AND SCATTERING IN PHOTOMETRIC EXPERIMENTS; THE EXTINCTION COEFFICIENT OF GASEOUS CHLORINE AT 4358 A.
M.J.Dignam and D.J.Le Roy.
J. chem. Phys., Vol. 26, No. 4, 964-5 (April, 1957).

A value of 1.51 x 10^3 cm^2 $mole^{-1}$ for the extinction coefficient is deduced. The discrepancy between this value and previously recorded results is attributed to inadequate correction.

G.I.W.Llewelyn

535.345

6012. ULTRAVIOLET TRANSMISSION OF CALCIUM FLUORIDE CRYSTALS AT LOW TEMPERATURES.
A.R.Knudson and J.E.Kupperian, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 5, 440-1 (May, 1957).

When the temperature is reduced from 290° to 77° K the transmission limit moves from 1210 to 1165 A. G.F.Lothian

535.345

6013. LIGHT ABSORPTION MEASUREMENTS ON SILVER HALIDE CRYSTALS AT HIGHER TEMPERATURES. R.Matejec.
Z. Phys., Vol. 147, No. 5, 593-9 (1957). In German.

Crystals of Ag halides formed between quartz plates showed the long wavelength tail of the absorption curve extending further into the visible as the temperature increased up to 540° C, with a sudden larger shift at the melting point. This was more sharply defined for AgBr than for AgCl. Slow cooling reversed the changes. Several hours' heating at 500-600° C produced a new absorption band centred at about 7200 A due to the formation of colloidal Ag, which disappeared on cooling. This colloidal Ag was not increased in quantity by exposure to white light at the high temperature. Colloidal Ag produced by light at room temperature granulated on heating and was not reabsorbed; it gave general optical absorption, not the band at 7200 A. S.T.Henderson

535.37

6014. ON THE LUMINESCENCE OF SODIUM CHLORIDE.
H.Adler and F.Stegmüller.
Acta phys. Austriaca, Vol. 11, No. 1, 31-58 (1957). In German.

Luminescence of natural rocksalt and NaCl grown from the melt was studied with glow-curve, spectrograph and absorption measurements. Some discrepancies in the results are discussed. J.Franks

535.37

6015. AN APPLICATION OF THE LINEAR METALLIC MODEL.
E.Laffitte.
Cahiers de Phys., No. 75-6, 64-6 (Nov.-Dec., 1956). In French.

From calculations of the orientation of absorption and emission oscillators in a fluorescent molecule, the variation of polarization of the emitted light with wavelength of the exciting light can be obtained. J.Franks

535.37

6016. PHOTOLUMINESCENCE OF THALLIUM CHLORIDE.
A.S.Výsochanskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 2, 228-31 (1957). In Russian.

The absorption spectrum of TlCl phosphors was found to contain not only a maximum at 2490 A, but also two other maxima at 3520 and 3800 A, which were very weak in the case of pure and non-irradiated phosphors, and distinct after illumination, disappearing again when the phosphor was treated with gaseous Cl; hence they seem to be caused by the appearance of excess Tl in the crystal lattice. The excitation maxima of the TlCl luminescence were also near 3520 and 3800 A. In the luminescence spectrum of all kinds of TlCl phosphors (powders, melts, and fused-in layers) two luminescence bands were found, with maxima near 4650 and 6300 A. Their intensity was found to depend on the heat treatment and amount of ultraviolet irradiation, an excess in either leading to a decrease in luminescence; treatment with Cl or HCl restored the phosphor to the original state. When Tl was deposited by vacuum technique on a non-irradiated preparation, it emitted light as if it were heat-treated or irradiated. F.Lachman

535.37

6017. EFFECT OF THE ADSORPTION OF GASES ON THE LUMINESCENCE OF ZINC OXIDE. K.V.Tagantsev and A.N.Terenin.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 2, 241-4 (1957). In Russian.

An aqueous suspension of ZnO obtained by burning Zn in air was spread on glass plates which were then heated for several hours at 200° or 400° C in a high vacuum. The luminescence was excited by a Hg lamp and measured with a photoelectric photometer. The measurements were conducted (1) after continuous illumination, and (2) after short (10 sec) illuminations with dark intervals of ≥ 5 min, with or without added vapours or gases. Dark-period adsorption of H_2O or O_2 was found to quench markedly the luminescence; a particularly intense quenching was shown by quinone and by O_3 which was shortly before subjected to a weak electrodeless discharge (probably O_2). The luminescence of ZnO, quenched by O_3 during short illuminations, was found to flare up at higher O_2 pressures and continuous illumination, this phenomenon being reversible and probably due to photodesorption of O_2; similar behaviour was found with O_3, H_2O and quinone vapour. A tentative theoretical explanation is given. F.Lachman

535.37

6018. BORATE PHOSPHORS WITH ULTRAVIOLET EMISSION.
H.Witzmann, R.Müller and G.Semisch.
Naturwissenschaften, Vol. 43, No. 24, 580 (1956). In German.

Strontium borate activated with Pb is excited by short-wave ultraviolet. S.T.Henderson

535.37

6019. TUNGSTATE–SILICATE MIXED PHOSPHORS.
H.Witzmann and W.Plamann.
Naturwissenschaften, Vol. 43, No. 24, 580 (1956). In German.

The blue photoluminescence of $CaWO_4$ is intensified by small additions of SiO_2. If $CaWO_4$ and $CaSiO_3$:PbMn are fired together both visible emission bands are intensified but not displaced. The luminescence of either $ZnWO_4$ or Zn_2SiO_4 : Mn is depressed by firing with components of the other, though the silicate shows enhanced phosphorescence. S.T.Henderson

535.37

6020. THE PROBLEM OF THE MECHANISM OF THE LUMINESCENCE OF ALKALI HALIDE CRYSTAL PHOSPHORS.
L.M.Shamovskiĭ.
Optika i Spektrosk., Vol. 1, No. 3, 407-15 (1956). In Russian.

Essentially a discussion of some 32 quoted papers (14 Soviet) bearing on the luminescence mechanism of alkali halide phosphors. The microheterogeneous structure and the dual nature of the distribution of the activator are taken into account. C.R.S.Manders

535.37

6021. LAW OF ATTENUATION OF AFTERGLOW OF ZnS PHOSPHORS CLOSE TO AND IN THE REGION OF TEMPERATURE EXTINCTION. F.I.Vergunas.
Optika i Spektrosk., Vol. 1, No. 3, 416-26 (1956). In Russian.

To account for the observed behaviour of the afterglow of ZnS phosphors in the temperature extinction region after the exciting light has been cut-off the author assumes that the kinetics of extinction change from monomolecular to bimolecular type. C.R.S.Manders

535.37

6022. TEMPERATURE VARIATION OF ABSORPTION IN SULPHIDE PHOSPHORS. P.S.Litvinova.
Optika i Spektrosk., Vol. 1, No. 3, 427-32 (1956). In Russian.

The experimental part of the work consisted in measuring the emission and absorption, and their variation with temperature. Curves are given for ZnS:Zn, ZnS:Cu, ZnS:Mn, also ZnS:Cu:Fe and ZnS:Cu:Co. It is concluded from the curves given that temperature extinction of luminescence is associated with growth of absorption in the extinction region. C.R.S.Manders

535.37

6023. LUMINESCENCE FROM SODIUM CHLORIDE. W.E.Spicer.
Phys. Rev., Vol. 106, No. 4, 726-32 (May 15, 1957).

The X-ray-induced luminescence from NaCl has been studied in the range from 2.1 to 5.2 eV and in certain cases correlated with optically induced luminescence. The intensity and spectral distribution of the X-ray-induced luminescence was found to be dependent on the previous heat treatment received by the crystal. Before heating, bands are present at 2.25, 3.1, and 5.0 eV; afterwards, strong new bands appear at 2.45 and 3.5 eV and the intensity of the 5.0 eV band is increased. Prolonged X-irradiation reduces most of the effects of heat treatment; however, following such prolonged X-irradiation, a relatively strong band is present at 2.9 eV. In the heated crystals, it was found possible to induce the 2.45 and 3.5 eV bands by irradiating X-ray-coloured crystals with light absorbed in the F-band; thus indicating that these bands are probably due to electronic transition from the conduction band into lower lying levels. An afterglow due to the thermal ejection of the electrons from traps was found and studied in conjunction with the optically induced luminescence. The same bands were present in the optically induced luminescence as in the afterglow. A.

535.37 : 534.222.2

6024. LUMINESCENCE OF THE SHOCK-WAVE FRONT.
Yu.P.Lun'kin and G.I.Mishin.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1105 (1956). In Russian.

Suggests an explanation of the luminescence observed in many gases (Eckerman and Schwartz, Phys. Rev., Vol. 87, 912, 1952). When molecules in the front of the shock wave collide with each other, the energy of ordered motion is transformed into disordered heat energy. Zener (Phys. Rev., Vol. 37, 556, 1931) showed that, after roughly 10 collisions, a Maxwellian velocity distribution is established, while the rotational and vibrational degrees of freedom remain practically "frozen". The entire energy passes only into the translatory degrees of freedom, and the local gas temperature becomes much higher than that resulting from the thermodynamical equilibrium. Later, the electronic levels and rotational degrees of freedom are excited, while the local temperature remains still above the equilibrium temperature. F.Lachman

535.371

6025. ROLE OF COLLISION TRANSFER IN FLUORESCENT SOLUTIONS. R.Hardwick.
J. chem. Phys., Vol. 26, No. 2, 323-4 (Feb., 1957).

The importance of energy transfer by collision (used in the sense of diffusion together of an excited and an unexcited molecule) has been investigated by measuring the fluorescence of nearly identical solid and liquid solutions under like conditions. Since the solids seem to transfer as well as the liquids, the conclusion is made that the "collision" mechanism does not play a major part in this type of transfer. A.

535.371

6026. FLUORESCENCE EFFICIENCIES OF ORGANIC COMPOUNDS. M.Furst, H.Dallmann and F.H.Brown.
J. chem. Phys., Vol. 26, No. 5, 1321-1 (May, 1957).

The relative fluorescence efficiencies of a large number of organic compounds of different structures were measured in solution under high-energy and ultraviolet excitations. P/R values of the more efficient solutes under high-energy excitation are given. Where possible at room temperature the fluorescence under high energy was also determined for the compound in solid form. A considerable parallelism is found between the relative fluorescence efficiencies in solution under both modes of excitation. Oxygen effects were measured and found to be greater on the solvent than on the solute, but do not greatly influence the relative efficiencies. Changes in fluorescence produced by substituents which do not considerably alter the absorption spectrum are discussed. A.

535.371

6027. MEASUREMENTS OF RISE AND DECAY TIMES OF STIMULATED EMISSION FROM PHOSPHORS.
G.Cheroff and S.P.Keller.
J. Opt. Soc. Amer., Vol. 47, No. 5, 440 (May, 1957).

An apparatus is described for measuring rapid rise and decay times of stimulated emission. Infrared stimulable sulphides of Sr and Ca activated with Ce, Eu and Sm had decay times of 8 and 100 μsec. J.Franks

535.371

6028. THE GREEN-2 BAND IN THE ULTRA-VIOLET LUMINESCENCE OF ZINC SULPHIDE.
T.B.Tomlinson and E.A.D.White.
J. Electronics, Vol. 2, No. 4, 404-5 (Jan., 1957).

Experimental results are given which suggest that the green band for high copper concentrations in zinc sulphide is due to the same centre as the emission for low concentrations. At the high densities involved interaction between Cu^+ and Cl^- ions present is likely. G.F.J.Garlick

535.371

6029. REVERSIBILITY OF FLUORESCENCE BY ANNEALING.
K.Przibram.
Nature (London), Vol. 179, 319-20 (Feb. 9, 1957).

Under 3650 A radiation many minerals show bluish-green fluorescence due to adsorbed water which may be removed by strong heating. The fluorescence is regenerated by moderate reheating, which appears to cause stronger binding of water loosely adsorbed on the surface during the cooling process. S.T.Henderson

535.371

6030. REVERSIBILITY OF FLUORESCENCE BY ANNEALING.
K.Przibram.
Nature (London), Vol. 179, 864 (April 27, 1957).

Some of the effects previously described (see preceding abstract) are due to particles of skin transferred to the minerals by handling. S.T.Henderson

535.371

6031. INFLUENCING OF THE LUMINESCENCE PROPERTIES OF PHOSPHORS BY H_2^+ IONS. W.Martin.
Z. Phys., Vol. 147, No. 5, 582-92 (1957). In German.

Various phosphors were bombarded by H_2^+ ions of maximum energy 45 keV. The zinc sulphides with Ag or Cu activator were much more sensitive than Mn-activated or non-activated phosphors. Glow curves showed greater light output and more deep traps for the treated materials, which also had slower decays than before. Bombarded sulphides had a faster fall of brightness with increasing temperature, while the damage could be increased by treatment above room temperature. The damage depended on the number, not the energy of the ions. Regeneration to near the original state occurred under bombardment by 40 keV electrons. S.T.Henderson

535.371.08

6032. DETERMINATION OF THE ABSOLUTE QUANTUM YIELD OF FLUORESCENT SOLUTIONS. G.Weber and F.W.J.Teale.
Trans Faraday Soc., Vol. 53, Pt 5, 646-55 (May, 1957).

A method for the determination of the absolute quantum yield of the fluorescence of solutions is described. This method uses the dipolar scattering of monochromatic light from glycogen solutions as a standard of unit quantum yield against which the fluorescence from a solution with the same apparent optical density of the exciting wavelength is compared. If both scattering and fluorescence are purely dipolar emissions, the linear polarization of the radiation emitted at right-angles to the direction of excitation is sufficient to characterize completely the spatial distribution of the radiation and together with the ratio of the intensities emitted in the same direction permits a comparison of the total emission from the two sources. The quantum yields of solutions of 28 substances, the fluorescence spectra of which range from 280 to 720 mμ, have been investigated and the results show satisfactory agreement with the most reliable values previously obtained by other methods. A.

535.372

6033. ON THE FLUORESCENCE OF PARA-BROMOTOLUENE, ORTHO-BROMO AND ORTHO-CHLOROTOLUENE IN THE SOLID STATE AT LOW TEMPERATURE. D.C.Biswas.
Indian J. Phys., Vol. 30, No. 8, 407-14 (Aug., 1956).

The fluorescence spectra of p-bromotoluene in the solid state at −40°C and −180°C and those of o-bromotoluene and o-chlorotoluene at −180°C and the spectra of these molecules dispersed in frozen solutions in different solvents have been investigated using mainly the group of Hg lines at 3650 A as the exciting radiation. The fluorescence spectra of these substances undergo changes when they are dispersed in different frozen solvents, the nature of the change being dependent on the nature of the solvent used. Finally, it is pointed out that the nature of the fluorescence bands given by these substituted toluenes is almost the same, but the position of the band system depends on the mode of the substitution and that this fact precludes the possibility of attributing this fluorescence to the presence of some common impurity in all these compounds. A.

535.375.5

6034. STRUCTURE OF THE RAMAN SCATTERING BAND CHARACTERISTIC OF THE VIBRATION OF THE CARBONYL KETONIC GROUP IN THE REGION 1700 cm^{-1}. E.Gray.
Cahiers de Phys., No. 71-2, 71-2 (July-Aug., 1956). In French.

The 1700 cm^{-1} band has been studied by observations on pure cyclopentanone, cyclohexanone, methylethylketone, butyrone, and methylhexylketone and on solutions of these ketones in CCl_4. The band position varies from ketone to ketone, but is unaffected by dilution. G.I.W.Llewelyn

535.375.5 : 539.132

6035. THE ROTATIONAL STRUCTURE OF THE 217 cm^{-1} BAND OF THE RAMAN SPECTRUM OF CARBON TETRACHLORIDE. P.D.Simowa.
C.R. Acad. Bulg.Sci.,Vol.9, No. 2, 9-12 (April-June, 1956). In German.

The separation of the maxima of the O and S branches of the 217 cm^{-1} band is measured at $\Delta\nu$ = 29 cm^{-1} in CCl_4 at 60°C. The rotational constant B is calculated at 0.057 cm^{-1} and the moment of inertia I = 490 x 10^{-40} g. cm^2. G.Allen

535.375.5 : 539.132

6036. RAMAN SPECTRA, VIBRATIONAL ASSIGNMENTS, AND FORCE CONSTANTS FOR BH_3CO AND BD_3CO. R.C.Taylor.
J. chem. Phys., Vol. 26, No. 5, 1131-5 (May, 1957).

Raman spectra of BH_3CO and BD_3CO have been obtained for the liquid state at −80°C, and a complete assignment of the sixteen fundamentals of the two molecules has been made with the help of the Teller–Redlich product rule and a normal coordinate treatment. The calculations were carried out using the FG method of Wilson, ten symmetry force constants being required to produce a fit with a standard deviation of 0.3% from the observed fundamentals. Extension of the calculations to include the isotopic B^{10} molecules gave results in agreement with the data available. A.

535.375.55 : 523.785

6037. STRUCTURE BY RAMAN EFFECT OF THE MOTHER SOLUTION OF AN IONIC CRYSTAL. R.Lafont.
Cahiers de Phys., No. 71-72, 69-71 (July-Aug., 1956). In French.

The Raman spectra of a saturated solution of $ZnSO_4$ and of the $ZnSO_4.7H_2O$ crystal have been determined. From the similarity between the spectra, it is suggested that the structure of a saturated solution of a salt is identical to that of the nascent crystal in the solution. G.I.W.Llewelyn

535.375.55

6038. RAMAN SPECTRUM OF TRIETHYLBORANE. E.J.Blau and B.W.Mulligan.
J. chem. Phys., Vol. 26, No. 5, 1085-8 (May, 1957).

Frequency shifts and polarization data are reported for the Raman spectrum of liquid triethylborane, $B(C_2H_5)_3$. By comparison with the spectra of trimethylborane and ethane, tentative assignments are made for most of the observed bands. A.

535.375.56

6039. ON THE RAMAN SPECTRA OF 1,1-DICHLOROETHANE AND 1,1,1-TRICHLOROETHANE IN THE VAPOUR STATE. M.Mazumder.
Indian J. Phys., Vol. 30, No. 8, 384-9 (Aug., 1956).

The Raman spectra at 100°C and 125°C have been studied and compared with those of the substances in the liquid state at about 30°C and at temperatures nearly equal to those of the vapours. It is observed that there is no appreciable change in the spectra with the change of temperature of the liquids, but as soon as the liquids are transformed into the vapour phase, the frequency-shifts of some prominent lines increase and a few prominent Raman lines become much broader. These changes have been explained on the assumption that one half of the molecule in each case rotates freely about the C–C bond in the vapour state and probably the frequencies of the corresponding vibrations in the molecules in which the two halves are mutually orientated in such a way that the C–H bonds in the two halves are in the same plane (eclipsed), may be slightly different from those due to the molecules in which one of the C–H bonds is rotated from the orientation mentioned above through 60° about the C–C bond (staggered). It is also pointed out that in the liquid phase intermolecular field prevents such free rotation about the C–C bond. A.

535.376

6040. AGING CHARACTERISTICS OF ELECTROLUMINESCENT PHOSPHORS. S.Roberts.
J. appl. Phys., Vol. 28, No. 2, 262-5 (Feb., 1957).

The brightness, B, of electroluminescent light sources is observed to decay gradually as a function of operating time, t, according to the empirical formula, $B = B_0/(1 + t/t_c)$, where B_0 is the initial brightness and t_c is the time to half-brightness. At 60 c/s the values of t_c range in the hundreds to thousands of hours, while at 5000 c/s t_c is observed to be less than 100 hr for the particular phosphor used. The value of t_c depends slightly, if at all, on voltage; but a very significant change in the voltage dependence of brightness occurs during the ageing process. The results are interpreted on the basis of the Piper–Williams theory and are thought to be consistent with a field-induced migration of the deep donor impurity. A.

535.376

6041. VOLTAGE DEPENDENCE OF ELECTROLUMINESCENCE OF POWDERED PHOSPHORS. W.Lehmann.
J. Electrochem. Soc., Vol. 103, No. 12, 667-72 (Dec., 1956).

The time-average electroluminescent emission intensity, L, of powdered phosphors has been measured over wide ranges of the applied sinusoidal voltage, V. The best fit for moderate and high voltages has been obtained with $L = A \exp[-B/(V + V_0)]$. The emission intensity of all phosphors goes to a finite saturation value if the applied voltage becomes very large. The approach to this saturation is given by $L = A \exp(-B/V)$. The saturation brightness, A, is in almost all cases proportional to the applied frequency. Since the emission of the particles of a powdered electroluminescent phosphor is in general very nonuniform, the over-all emission intensity, L, must be the integral over all volume elements, $d\nu$, of the local brightness β. This integral fits the experimental results if $\beta = a \exp(-b/cF)$ and $cF = V$. It is believed that normally a and b are essentially constant in this integral but that the constant of proportionality, c, between the electric field strength, F, and the voltage, V, obeys a certain statistical distribution throughout the phosphor due to the complex geometrical structure of the phosphor. A.

535.376

6042. TEMPERATURE DEPENDENCE OF ELECTROLUMINESCENCE. C.H.Haake.
J. Electrochem. Soc., Vol. 104, No. 5, 291-8 (May, 1957).

Electroluminescent brightness measurements were carried out on several zinc sulphide phosphors over wide ranges of temperature and frequency. From the temperature dependence of photoluminescence a thermal extinction factor was derived which, when introduced in the electroluminescent brightness values, led to an ideal electroluminescent brightness unaffected by thermal quenching. In general, this ideal brightness was found to increase or tend to saturation with increasing temperature, but did not decrease. The temperature sensitivity of the ideal electroluminescence is explained on the basis of a two-step mechanism: the excitation process and the return process. Luminescence is assumed to occur only during the latter process. On the phosphors studied the temperature dependence of the ideal electroluminescent brightness seems to be due mainly to the thermal behaviour of traps during the return process, since the electron return is impeded by traps. A.

535.376

6043. MECHANISM OF THE ELECTROLUMINESCENCE OF ZINC SULPHIDE. R.Goffaux.
J. Phys. Radium, Vol. 18, No. 1, 1-4 (Jan., 1957). In French.

A theory of electroluminescence based on Wise's model and Fröhlich's concept of free electron temperature leads to an expression for the density of free electrons in the solid. The main deductions are (1) that the light output should depend linearly on frequency over a certain range and at higher frequencies tend to saturate; (2) that the electroluminescent state should require a time of the order of 10^{-2} sec for its establishment; (3) that the light output should be periodic but not sinusoidal for sinusoidal excitation. Experiment confirms these deductions. The theory also appears to agree satisfactorily with the experimental results of Mattler, Destriau and others on brightness waveforms, temperature effects, and voltage–brightness relations. S.T.Henderson

535.376

6044. THE ELECTROLUMINESCENCE OF ZnS TYPE PHOSPHORS. P.Zalm.
Philips Res. Rep., Vol. 11, No. 5, 353-99 (Oct.); No. 6, 417-51 (Dec., 1956).

Electroluminescence occurs in the presence of a conducting phase on the surface of activated ZnS grains. Measurements were made of the variation of emittance with amplitude and frequency of the applied voltage on ZnS powders with Cu and other activators, embedded in insulating and conducting media. Oscillograms of the emitted light-flashes for various applied waveforms, and build-

up phenomena indicated that when field excitation does not ionize the activators the light emission is virtually in phase with the voltage, while under conditions of ionization a phase-shift occurs. The voltage dependence of the emittance is due to a Mott–Schottky barrier; electrons in the conduction band are accelerated to cause excitation or ionization. In crystals embedded in dielectric without d.c. contact to electrodes the Mott–Schottky barrier extends over a limited area and depth owing to polarization effects. The model accounts for the delayed light emission and the temperature dependence of emittance. In electroluminescent hexagonal ZnS:Cu single crystals, excitation occurs at internal barriers, which have a rectifying effect. These barriers are crystallographically oriented.

J.Franks

535.376

6045. PHOTOELECTROLUMINESCENCE WITH VISIBLE RESPONSE. D.A.Cusano.
Phys. Rev., Vol. 106, No. 3, 604-5 (May 1, 1957).

Behaviour similar to that of ZnS:Mn:Cl (Abstr. 5343/1955) is shown when Mn is replaced by As or P. Spectral excitation and emission curves are given for the new materials: they have broader bands than the Mn phosphor. The amplification of electroluminescent output with increasing input of 3650 A radiation is shown graphically for ZnS:As:Cl.

S.T.Henderson

535.377 : 537.583 : 537.311.33

ELECTRONIC CONDUCTIVITY, THERMOLUMINESCENCE AND THERMIONIC EMISSION IN IONIC CRYSTALS. See Abstr. 5313

535.39

6046. THEORETICAL STUDY OF THE OPTICAL PROPERTIES OF THIN TRANSPARENT FILMS. P.Bousquet.
Ann. Phys. (Paris), Vol. 2, No. 1-2, 5-15 (Jan.-Feb., 1957). In French.

General formulae are found for the complex reflection and transmission coefficients, firstly for the interface between two media and then for a thin film. All the various media can be absorbent, anisotropic or dichroic. The formulae are shown to reduce to the conventional form in the case of a single layer where both the layer and its support are transparent, homogeneous and isotropic.

E.A.Mussett

535.39

6047. RECURRENCE FORMULAE FOR THE REFLECTANCE AND TRANSMITTANCE OF MULTILAYER FILMS WITH APPLICATIONS. G.H.Godfrey.
Austral. J. Phys., Vol. 10, No. 1, 1-15 (March, 1957).

Formulae are developed which, by repeated applications, give the changes in amplitude and phase when light passes normally through any number of layers of homogeneous absorbing or transparent materials. These formulae are suitable for numerical computation and provide a direct route to the analytical expressions for the reflectance and transmittance in particular cases. Special attention is given to the case in which the layers are a quarter wave or multiples of a quarter wave in thickness.

A.

535.39 : 539.234

6048. DIELECTRIC THIN FILMS. O.S.Heavens and S.D.Smith.
J. Opt. Soc. Amer., Vol. 47, No. 6, 469-72 (June, 1957).

The factors which influence the properties of dielectric films formed by thermal evaporation are discussed. Detailed results are given for several materials which are of practical importance. The results obtained for the refractive index of transparent films (a) by the Brewster angle method and (b) by the measurement of film reflectance are considered. It is concluded that differences observed in certain cases cannot be ascribed to the use of different methods of measurement. Some tentatove comments are made on the connection between the observed mechanical stress and structure of films of ZnS, MgF_2, cryolite, LiF, and CaF_2.

A.

535.39 : 539.234

6049. OPTICAL PROPERTIES OF THIN ABSORBING FILMS. F.Abelès.
J. Opt. Soc. Amer., Vol. 47, No. 6, 473-82 (June, 1957).

Equations are given for the reflectances, transmittances, and phase changes by reflection and transmission of very thin absorbing films, i.e., films with a thickness d very small compared with the wavelength λ of the incident radiation. The similarities and differences between very thin homogeneous and inhomogeneous films are discussed, and some experimental results obtained on very thin gold and chromium films are presented. The reflectance and transmittance of these films were measured as a function of the angle of incidence φ_0 and of the state of polarization of the incident light. A new method is given for obtaining the optical constants of ionic crystals in the infrared. The optical properties of thick metallic films, with some new photometric methods for the determination of their optical constants, are discussed. The theory of the optical absorption of metals is briefly presented.

A.

535.39 : 539.234

6050. THICKNESS CONTROL OF THIN FILMS.
A.C.S.van Heel.
J. Opt. Soc. Amer., Vol. 47, No. 6, 483 (June, 1957).

535.391 : 535.91

6051. SCATTERED LIGHT IN THIN, DIELECTRIC MULTILAYERS. P.Giacomo.
Rev. Opt., Vol. 35, No. 12, 640-1 (Dec., 1956). In French.

An all-dielectric interference filter is mounted on the plane face of a semi-cylindrical lens, illuminated normally with white light and the transmitted light observed through the curved surface of the lens at various obliquities up to 75°. The cylindrical surface allows the scattered light to be observed in regions where it would normally be totally reflected by the rear surface of a parallel sided substrate. All the transmission spectra show interference bands indicating a significant scattering in the filter up to the highest obliquities.

E.A.Mussett

535.393 : 539.234

6052. OPTICAL CONSTANTS OF THIN SILVER FILMS.
R.Philip and J.Trompette.
J. Phys. Radium, Vol. 18, No. 2, 92-8 (Feb., 1957). In French.

The thicknesses and complex refractive indices of several films between 40 and 730 A thick, were measured by the method due to Malé (Abstr. 3272/1954), for light of wavelengths between 3000 and 6000 A. Of several theoretical interpretations considered, the theory due to David (1939) was considered to give the best fit and led to an order of magnitude assessment of the crystallite size in the films.

D.G.Avery

535.393 : 539.234

6053. OPTICAL PROPERTIES OF THIN PALLADIUM FILMS.
D.Malé and J.Trompette.
J. Phys. Radium, Vol. 18, No. 2, 128-30 (Feb., 1957). In French.

The constants of evaporated films were determined over the thickness range 50 to 300 A. The films were found to have quite constant reflectivity over the wavelength range studied from 3000 to 5500 A.

D.G.Avery

535.393 : 535.514 : 539.23

6054. OPTICAL STUDIES OF METAL SURFACES. ESPECIALLY ON THE USE OF THE REFLECTED-POLARIZED-LIGHT METHOD IN INVESTIGATING SURFACE FILMS. A.B.Winterbottom.
K. Norske Vidensk. Selsk. Skr., 1955, No. 1, 149 pp.

A monograph which gives a summary of work done by the author since 1934 on thin film optics, especially discussing the polarimetric method.

S.Tolansky

535.399

6055. GALLIUM OXIDE GLASSES.
P.L.Baynton, H.Rawson and J.E.Stanworth.
Nature (London), Vol. 179, 434-5 (Feb. 23, 1957).

Experiments leading to the production of a glass of composition CaO 33.4, Ga_2O_3 59.6 and SiO_2 7% are described. The glass has a refractive index of about 1.7 and a markedly better transmission in the region 1-5 μ than the corresponding aluminate glass.

R.W.Fish

535.4

6056. LATEST WAVE IN PHYSICAL OPTICS. F.Zernike.
J. Opt. Soc. Amer., Vol. 47, No. 6, 466-8 (June, 1957).

An increased interest in physical optics started about 1930. The paper gives a personal selection of some special topics. First, light rays are shown to be different from the paths of the energy. The diffraction patterns of lens errors cannot even approximately be found from the geometric patterns. The new concept of partial coherence is treated next. It has been made possible by introducing a less stringent definition of incoherence. Total reflection causes an absolute phase-shift strongly dependent on the angle of incidence. This explains a ray displacement predicted from wrong premises by Goos and Hänchen. Even the old relative phase-shift, as in the Fresnel rhomb, gives rise to a new effect, namely, a destructive interference between the two halves issuing from a roof prism. Phase differences which are otherwise unobservable become visible on a coherent background, which is obtained in a simple and accurate way by diffraction.

A.

535.41

6057. APPLICATIONS OF COHERENCE THEORY IN MICROSCOPY AND INTERFEROMETRY. H.H.Hopkins.
J. Opt. Soc. Amer., Vol. 47, No. 6, 508-26 (June, 1957).

The formulation of the theory of spatial (monochromatic) coherence is reviewed, together with some of the more immediate applications. These include the conditions for effectively coherent and incoherent illumination, the theory of stellar interferometry, and the interference microscope. A general treatment of the influence of the size of source on the visibility of the fringes in two-beam interferometers is given, together with applications. The use of coherence theory in microscopy is then summarized, and the influence of the numerical aperture of the illuminator is illustrated in special cases. These include the images of two close point apertures, a narrow slit, and a periodic structure. It is shown how the concept of an "effective source" facilitates the study of the influence of aberrations under different conditions of coherence. The paper concludes with a discussion of the theory of chromatic coherence. A.

535.41 : 535.5

6058. POLARIZATION APPARATUS FOR INTERFERENCE MICROSCOPY AND MACROSCOPY OF ISOTROPIC TRANSPARENT OBJECTS. M.Françon.
J. Opt. Soc. Amer., Vol. 47, No. 6, 528-35 (June, 1957).

The various instruments described are based on the following principle: a wave-front which has been deformed by optical path difference variations in the object is doubled into two identical wave-fronts by means of a birefringent system. The interference phenomena between these two wave-fronts bring out the path difference variations in the object. By this means the transparent object is made visible. The birefringent systems employed are mainly of the Savart polariscope and Wollaston prism types. They can be equally well used in microscopy. These instruments can be used by means of adequate modifications, without any collimation. In the latter case they are extremely luminous. They are of particular interest in microscopy where they permit the measure of refractive indexes and of thicknesses of small details in preparations. A very simple differential observation method is described which places in evidence the gradient of the optical path. The sensitivity of the method depends on the width of the object. It is of the order of $\lambda/50$ for an object 1 mm wide. This sensitivity can therefore be very large for very small objects. A.

535.41

6059. SOME QUANTITATIVE MEASUREMENTS OF PATH DIFFERENCES AND GRADIENTS BY MEANS OF PHASE CONTRAST AND NEW INTERFEROMETRIC DEVICES. E.Ingelstam.
J. Opt. Soc. Amer., Vol. 47, No. 6, 536-44 (June, 1957).

The phase-contrast method has initiated much work in microscopy, and outside this field it has been applied in the design of a differential refractometer for gases and liquids. This instrument has undergone modifications during the last few years and is now applicable for registration of streaming liquids and measurements of stationary fluids (E.Djurle). With the electronics operating as a null indicator the analysis of heavy water in ordinary water is made possible within 0.001%. For phase gradients within a cell containing liquids the phase-contrast method presents some difficulties; an ideal solution is the birefringence interferometer proposed by Jamin but in the shape now advised by Francon. It is shown how this method is applied for accurate registration of a gradient by means of an electronic null method, and for the specific information required for obtaining diffusion constants with extremely simple methods. An isotropic compensator for microscopy has been introduced (L.Johansson), by means of which measurements are made on biological specimens rapidly and accurately that the accuracy by a colour-matching method based on this compensator comes out to plus or minus 10 A (L.Johansson–B.Afzelius). A.

535.417

6060. ON THE PRINCIPAL ERRORS OF MEASUREMENT IN SCHLIEREN AND INTERFERENCE METHODS. H.Wolter.
Ann. Phys. (Leipzig), Vol. 19, No. 1-2, 1-9 (1956). In German.

The limits of sensitivity are roughly the same for both methods, but the experimental limits of error are higher for schlieren methods. The scatter of the measured values (e.g. of refractive index) is equal to the geometric mean of the limit of sensitivity and the experimental limit of error. B.T.M.Willis

535.417

6061. INTERFEROMETRY FOR THE FAR INFRARED. J.Strong.
J. Opt. Soc. Amer., Vol. 47, No. 5, 354-7 (May, 1957).

Describes the current effort aimed to apply new interferometric procedures to far infrared spectroscopy, out to millimetre waves, and describes the beginnings of plans to use interferometry in a telescope above atmospheric absorption. A.

535.417

6062. COMMON-PATH INTERFEROMETER FOR TESTING PURPOSES. J.Dyson.
J. Opt. Soc. Amer., Vol. 47, No. 5, 386-90 (May, 1957).

The interferometric method of optical testing presents considerable advantages in view of the unequivocal nature of the information given and the self-calibrating nature of the test. However, difficulties are presented in practical applications of interferometers of the Twyman–Green type because of the necessity of providing a reference beam. Two types of interferometer are described in which the reference beam follows the same path as the test beam, thus avoiding this difficulty. Some test results are given, illustrating a few of the applications of these instruments. A.

535.417 : 535.42

6063. CONSTRUCTION OF A MACH–ZEHNDER INTERFEROMETER FOR THE STUDY OF THE PERTURBATIONS OF A LIGHT WAVE IN THE VICINITY OF AN OBSTACLE. J.C.Viénot
J. Phys. Radium, Vol. 18, No. 2, 138-40 (Feb., 1957). In French.

The requirements, construction and adjustment of the instrument are described. It is used to examine the wave deformation caused by a straight edge. E.A.Mussett

535.417

6064. REFLECTING MULTIDIELECTRIC LAYERS APPLIED TO THE FABRY–PEROT INTERFEROMETER: THEORETICAL AND EXPERIMENTAL STUDY OF REAL FILMS. P.Giacomo.
Rev. Opt., Vol. 35, No. 8-9, 442-67 (Aug.-Sept., 1956). In French.

Continuation of previous paper (Abstr. 295/1957). The light absorption in single thin layers of cryolite and ZnS found experimentally by measuring the extreme values of the reflectivity or the transmissivity of the layer during its vacuum deposition on to glass is found to be insufficient to account for the absorptions possessed by multilayers. The theory of the measurement and experimental details are given. The explanation is sought in the scattering which occurs at irregularities in the surfaces of the multilayers. The theory for such scattering is developed for a Fabry–Perot filter and experiments are described which confirm that an appreciable amount of light is so scattered. The apparent absorption of the filter arises from both this scattering and the intrinsic absorption in the layers and the relative importance of these causes is discussed. E.A.Mussett

535.42 : 538.566

6065. DIFFRACTION BY AN APERTURE. J.B.Keller.
J. appl. Phys., Vol. 28, No. 4, 426-44 (April, 1957).

Diffraction of a wave by an aperture of any shape in a thin screen is treated by a new method — "the geometrical theory of diffraction". This is an extension of geometrical optics which accounts for diffraction by introducing new rays called diffracted rays. They are produced when incident rays hit the aperture edge and they satisfy the "law of diffraction". A field is associated with each ray in a quantitative way, by means of the optical principles of phase variation and energy conservation. In addition "diffraction coefficients" are introduced to relate the field on a diffracted ray to that on the corresponding incident ray. By this method a simple formula is obtained for the field diffracted by any aperture. It yields the field in the aperture, the diffraction pattern and the transmission cross-section. Explicit formulae and numerical results are given for slits and circular apertures. The accuracy of the results increases as the wavelength decreases, but they are useful for wavelengths even as large as the aperture dimensions. A.

535.42 : 538.566

6066. DIFFRACTION BY AN APERTURE. II.
J.B.Keller, R.M.Lewis and B.D.Seckler.
J. appl. Phys., Vol. 28, No. 5, 570-9 (May, 1957).

The field diffracted by an aperture of any shape is evaluated asymptotically for small wavelengths on the basis of several approximate diffraction theories. These are the Kirchhoff method, its two customary modifications, and W.Braunbek's new modification. In each case, a double integral over the aperture is evaluated asymptotically, and contributions from interior stationary points, edge stationary points, and corners of the edge are obtained. The contributions from points of each type, according to all the theories examined are exactly of the form deduced by Keller using his geometrical theory of diffraction. The edge stationary points and the corners correspond respectively to rays singly diffracted from edges and

from corners. For edge-diffracted rays the Braunbek diffraction coefficients alone coincide with those given by the geometrical theory of diffraction, but the Braunbeck method does not apply to corner diffraction. None of these methods takes account of multiple diffraction as does the geometrical theory of diffraction. A.

535.42 : 538.566

6067. STUDY OF OPTICAL DIFFRACTION IMAGES AT MICROWAVE FREQUENCIES. M.P.Bachynski and G.Bekefi.
J. Opt. Soc. Amer., Vol. 47, No. 5, 428-38 (May, 1957).

Experimental investigations of the intensity distribution in the region of the focus of microwave lenses are described. The circularly symmetric lenses, made from the polystyrene plastic, were illuminated by a linearly polarized beam of radiation of 1.25 cm wavelength. Most of the measurements are presented in the form of intensity contours in planes both containing the principal ray and lying perpendicular to it. Images formed by nearly perfect optical systems and by systems suffering from various third-order monochromatic aberrations were examined. In most cases the results are compared with calculations made from the scalar-diffraction theory of optical systems. In general, good agreement between theory and experiment is found. Some preliminary measurements of the phase variations of the electromagnetic field in the vicinity of the focus are given and the results discussed. A.

535.42 : 531.717.1

6068. MEASUREMENT OF A PROFILE IN COHERENT LIGHT. J.C.Viénot.
Rev. Opt., Vol. 35, No. 10, 517-25 (Oct., 1956). In French.

The measurement of the diameter of a small object, such as a thread, is difficult with incoherent light because of the out of focus images of the third dimension. The diameter can be measured more precisely from the diffraction fringes formed with coherent light. Conditions are obtained for best definition and most accurate measurement. Sample results are quoted. R.W.Fish

535.421

6069. THE INTENSITY DISTRIBUTION FROM A PLANE GRATING WITH A TRIANGULAR GROOVE PROFILE. B.Hartenstein and W.Friedl.
Optik, Vol. 14, No. 3, 119-29 (March, 1957). In German.

A theoretical formula for the intensity distribution given by a plane grating is tested out using a grating with a triangular profile. The formula is corrected and converted into a useful form for practical application. The range of applicability of the formula is determined. The intensity curves are computed for the first six orders. The intensity distributions are illustrated graphically. S.Tolansky

535.43

6070. STUDY OF RAYLEIGH SCATTERING BY QUARTZ IN MONOCHROMATIC LIGHT. L.Taurel.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1755-6 (Nov. 26, 1956). In French.

Continuing earlier measurements (Abstr. 7877/1955) the scattering of quartz relative to benzene is found to be independent of wavelength for the range 4358-5790 A. G.F.Lothian

535.43 : 539.153

6071. ON THE COHERENCE OF THE PHENOMENON OF MULTIPLE SCATTERING OF LIGHT IN RESONANCE RADIATION. M.A.Guiochon, J.E.Blamont and J.Brossel.
C.R. Acad. Sci. (Paris), Vol. 243, No. 23, 1859-62 (Dec. 5, 1956). In French.

The magnetic resonance method of Brossel and Bitter (Abstr. 5993/1952) was employed to study the lifetime of the 6^3P_1 level of mercury over a temperature range of -35°C to $+20^\circ$C. The results were strongly temperature dependent, except at the lowest temperatures where a "true" lifetime of 1.19×10^{-7} sec is reported. The temperature dependence is explained in terms of multiple scattering. R.W. Nicholls

535.43 : 551.593.64

6072. SCATTERED LIGHT INTENSITIES FROM LARGE SPHERICAL PARTICLES. H.Walter.
Optik, Vol. 14, No. 3, 130-42 (March, 1957). In German.

The following are calculated from Mie theory: (1) the Mie coefficients (A_n, P_n) for $m = \infty$, $\alpha = 6, 18, 30, 60$; (2) the scattered intensities for directions making angles with the incident direction of 0°, 90°, 168°-180°, for $m = \infty$, $\alpha = 6, 10, 18, 30, 60$; and for $m = 1.33$, $\alpha = 6, 8, 10, 12, 15, 18, 25, 30, 45, 60, 90, 120, 180, 250$. The latter data are useful in considering anti-coronae (see H.C.van de Hulst, Abstr. 1196/1947). G.F.Lothian

535.514 : 539.27

6073. OPTICAL AND ELECTRON-MICROSCOPICAL OBSERVATIONS ON A POLARIZATION PHENOMENON OCCURRING IN OBLIQUELY EVAPORATED METAL LAYERS. L.Reimer.
Optik, Vol. 14, No. 2, 83-91 (Feb., 1957). In German.

Obliquely evaporated metal layers polarize visible light perpendicular to the evaporation direction. This polarization appears first for evaporation angles less than 20°, and the degree of polarization increases rapidly as the angle is reduced further. The phenomenon depends strongly on the wavelength, giving rise in some metals to a kind of dichroism. Electron-microscope observations show a regular arrangement of oblong crystallites in the evaporated layer. The degree of polarization in gold layers for a fixed evaporation angle depends on the layer thickness. B.T.M.Willis

535.514.2

6074. CALCULATION OF THE DEGREE OF POLARIZATION FROM THE COMPENSATION ADJUSTMENT OF A SET OF GLASS PLATES. A.Kawski.
Acta phys. Polon., Vol. 15, No. 5, 283-6 (1956). In German.

It is shown that, starting from Neumann's formulae for the intensity of light which has passed through a set of glass plates (allowing for multiple reflections from the plate surfaces), it is possible to develop a general formula for the degree of polarization in Arago's compensation method. Formulae of Gaviola and Pringsheim, and of Sevchenko (no reference) are shown to be special cases of the general formula which makes it possible to calculate the degree of polarization for any number of glass plates without calibrating the compensation set. F.Lachman

535.514.2

6075. THE MEASUREMENT OF THE DEGREE OF POLARIZATION WITH THE HELP OF A COMPENSATING PILE OF GLASS PLATES. A.Kawski.
Optik, Vol. 13, No. 11, 520-3 (Nov., 1956). In German.

Formulae are given for the degree of polarization produced by transmission of light through one, two, three and four glass plates. The absorption for a single plate is considered and discussed. H.G.Jerrard

535.515

6076. DISPERSION OF BIREFRINGENCE IN THE INFRARED OF UNIAXIAL CRYSTALS. A.M.Vergnoux.
Cahiers de Phys., No. 73, 41-4 (Sept., 1956). In French.

The variation of the observed birefringence $(n_o - n_e)$ of KH_2PO_4 and of $(NH_4)H_2PO_4$ with wavelength has been investigated and the results are tabulated. Curves of λ^2 against $\lambda^2/n_o - n_e$ are linear for low wavelengths but become parabolic with increasing values of λ^2. G.I.W.Llewelyn

535.551 : 539.213.1

6077. THE EFFECTS OF THE POLARISATION OF THE CONSTITUENT IONS ON THE PHOTOELASTIC BIREFRINGENCE OF THE GLASS. M.Tashiro.
J. Soc. Glass Technol., Vol. 40, 353T-362T (Aug., 1956).

The effects of the properties of constituent ions on the photoelastic birefringence of simple glasses were studied by adding alkali oxides and fluorides, alkaline earth oxides and fluorides, and other metal oxides to lead silicate and lead phosphate glasses. This study proves the postulate of W.A.Weyl that the birefringence of a stressed glass is the result of the mutual polarization of all anions and cations. The sign and the magnitude of the photoelastic birefringence of a glass are the result of two antagonistic effects: (1) an effect as the result of the deformation of polarizable anions, and (2) a counter-effect resulting from the deformation of the polarizable cations. The former makes the birefringence positive, and the latter, negative. A.

535.555

6078. OPTICAL PROPERTIES OF "CELLOPHANE". S.N.Gaythorpe.
Nature (London), Vol. 179, 322 (Feb. 9, 1957).

The properties of "Cellophane" in polarized light are discussed, and measurements of birefringence reported. It can be used to build a polarization step-wedge for a polarizing microscope. D.G.Avery

535.557 : 534.321.9

6079. DISPERSION OF ACOUSTICALLY-INDUCED DOUBLE-REFRACTION IN SEVERAL LIQUIDS. J.Badoz.
Cahiers de Phys., No. 74, 42-4 (Oct., 1956). In French.

This is measured in three organic liquids using polarized light and a photomultiplier with linear detector. Approximately, the measured dispersion is proportional to the calculated refractivity.

For polystyrene in benzene where the relative dispersion is eight times less than the calculated value, it is suggested that acoustic relaxation may be present. H.D.Parbrook

535.65

6080. CORRELATE FOR LIGHTNESS IN TERMS OF C.I.E.-TRISTIMULUS VALUES. I. C.L.Sanders and G.Wyszecki.
J. Opt. Soc. Amer., Vol. 47, No. 5, 398-404 (May, 1957).

In order to establish a correlate for lightness in terms of C.I.E.-tristimulus values, a simple experiment was performed using Munsell samples of value 5/. The observers compared each sample with a lightness scale and estimated the value of the neutral which would appear equally light. Analysis of the data by the least-squares method showed that a correlate for lightness may be calculated with good approximation from the tristimulus values by means of a second-degree equation, which, for constant lightness, may be interpreted geometrically as an hyperboloid in the C.I.E.-colour space. From this, it is concluded that the C.I.E. method of calculating luminous reflectance and using it as a lightness index does not conform with the visual sensation. It has been established that although the coefficients of the second-degree equation vary with field size and depend upon the individual observer, characteristic features of the results are maintained in each case. With respect to colour vision theory the nature of the results seems to indicate that the contribution of the violet receptor to the sensation of lightness decreases with field size. A.

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.8

6081. EFFECTIVE AND INEXPENSIVE SLITS FOR TEACHING PHYSICAL OPTICS. S.Chapman and H.Meese.
Amer. J. Phys., Vol. 25, No. 3, 135-8 (March, 1957).

A discussion is given of how sets of single, double, and multiple slits may be made for use in lecture demonstrations in physical optics courses where each student has his own set of slits through which a source is viewed with the naked eye. Very careful work is required with very high-grade photographic equipment. A.

535.81 : 771.351.4

6082. TELE-OBJECTIVE OF 500 mm FOCAL LENGTH AND REFLEX CAMERA UNIT.
Rev. Opt., Vol. 35, No. 8-9, 492-4 (Aug.-Sept., 1956). In French.

A catadioptric system of the Cassegrain type is described. It has all spherical surfaces and covers a standard 24 x 36 mm format, with a flat field. The back focal length is long enough to allow a reflex viewing unit to be inserted between the lens and the photographic film. Spherical aberration curves are given for the working aperture of f/6.3, corresponding to a nominal aperture of f/4.6. Field curvatures are also shown. R.W.Fish

535.822.17

6083. SOME CONSIDERATIONS AFFECTING THE DESIGN OF INTERFERENCE MICROSCOPES. J.Dyson.
J. Opt. Soc. Amer., Vol. 47, No. 6, 557-62 (June, 1957).

Presents an analysis of the various types of the qualities desirable in an interference microscope. Three classes are recognized based on the manner in which the reference field differs from the image field. Several instruments in each class are discussed, and it is concluded that, so far, the design of interference microscopes is of the nature of a compromise, some qualities being sacrificed in order to obtain others. A current example of such a compromise is described, where accuracy of path difference measurement is the desired end. A.

535.822.17

6084. OBJECTS TO TEST THE SENSITIVITY OF PHASE CONTRAST AND INTERFERENCE MICROSCOPES. E.Menzel.
J. Opt. Soc. Amer., Vol. 47, No. 6, 563 (June, 1957).

535.89

6085. A PARTIALLY WALL-STABILIZED XENON HIGH-PRESSURE LAMP FOR LIGHT LOADINGS. A.Bauer and P.Schulz.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 227-9 (1956). In German.

Describes an arc source in which the discharge is stabilized against a part of the quartz containing tube. The effect of the magnetic field of the current in the arc electrode leads is mentioned. Typical emission spectra are shown. The typical arc is operated at 3A, 12 atm pressure. J.D.Craggs

535.89

6086. A SOURCE OF LITHIUM LIGHT. M.K.Hargreaves.
Nature (London), Vol. 179, 434 (Feb. 23, 1957).

A lithium arc lamp burning in argon is a strong source of red light (6708 A). A construction is described which prevents damage of the glass envelope by the action of hot lithium metal. R.W.Fish

HEAT 536

536.2

6087. HEAT TRANSFER AT SMALL GRASHOF NUMBERS. J.J.Mahony.
Proc. Roy. Soc. A, Vol. 238, 412-23 (Jan. 8, 1957).

Rough physical arguments suggest that the heat transfer from a body, immersed in a fluid, should be determined by the heat-conduction equation alone whenever the Grashof number, G, associated with the problem is small. However, heat-transfer rates predicted in this fashion are not always in accordance with the experimentally determined values. It is shown that, while convection is negligible in comparison with conduction near the body, it becomes as important at distances from the body of the order $(G)^{-n}$, where n varies between $\frac{1}{3}$ and $\frac{1}{2}$ with the body shape. Whenever this distance is large in comparison with all the dimensions of the body the use of the conduction equation yields correct heat-transfer rates. If, however, this distance is small in comparison with the body length, the heat transfer may be calculated from the two-dimensional convection solution. An examination of the solutions in these two extreme cases reveals that the heat loss is the same as that by conduction to a certain surrounding surface maintained at ambient temperature. This interpretation enables certain qualitative deductions to be made for the case when the ratio of the lengths is neither large nor small. The agreement between theory and experiment is satisfactory. A.

536.2.08

6088. SIMPLE BRIDGE METHOD FOR THE MEASUREMENT OF THERMAL CONDUCTIVITY OF GASES AND GAS MIXTURES. M.P.Madan.
J. Franklin Inst., Vol. 263, No. 3, 207-12 (March, 1957).

A simple bridge (hot-wire) method for the measurement of thermal conductivity of gases or gaseous mixtures is discussed and its design developed. A rigorous mathematical theory is applied to calculate the various corrections and to obtain the value of the thermal conductivity in terms of the conveniently measured quantities. A.

536.2.08 : 536.222

6089. THERMAL CONDUCTIVITIES OF LIQUIDS: NEW DETERMINATIONS FOR SEVEN LIQUIDS AND APPRAISAL OF EXISTING VALUES. A.R.Challoner and R.W.Powell.
Proc. Roy. Soc. A, Vol. 238, 90-106 (Dec. 4, 1956).

A guarded hot-plate apparatus is described and used for absolute determinations of the thermal conductivities of liquids over the range 2 to 82°C. The liquids studied are water, heavy water (99.95% D_2O), glycerine, ethyl alcohol, toluene, medicinal paraffin and carbon tetrachloride. For each liquid graphical representation of the variation of thermal conductivity with temperature enables existing values to be compared with those of the present investigation. In general the results of Riedel are in best agreement. A.

536.2.0

6090. RAPID MEASUREMENT OF THERMAL CONDUCTIVITY BY TRANSIENT HEATING OF A FINE THERMO-JUNCTION. R.A.W.Hill.
Proc. Roy. Soc. A, Vol. 239, 476-86 (April 9, 1957).

Transient methods of measuring thermal conductivities of poor conductors are very rapid and can be applied to small systems. By recording the temperature of an electrically heated wire, the conductivity of the environment can be determined in a fraction of a second. Thus with a wire of radius 10^{-2} cm the measuring time is less than 0.1 sec and the effective overall radius of the system is about 0.1 cm; furthermore, the effective length can be reduced to about 1.0 cm by making the wire a thermojunction. Apparatus operating on this principle consists of radiofrequency current for heating the junction wires and an oscillograph for simultaneous recording of the thermo-e.m.f. Temperature–time curves are used to deduce the thermal conductivity of substances placed in contact with the wires. The method is very flexible and can be applied to

small, rapidly changing systems at high temperatures. The conductivities of certain liquids have been measured at room temperature. The values obtained generally lie within 10% of the accepted values. A.

536.2.08

6091. THEORY OF A NEW APPARATUS FOR DETERMINING THE THERMAL CONDUCTIVITIES OF METALS. S.T.Hsu.
Rev. sci. Instrum., Vol. 28, No. 5, 333-6 (May, 1957).

The principle of transient temperatures inside a semi-infinite solid is applied to two identical sets of composite plates. Each of these sets consists of a standard specimen of a certain metal whose properties are known and a test specimen of a metal whose thermal diffusivity is to be determined. When these two sets, initially at different but uniform temperatures, are brought into contact with each other, the transient temperature at the contact plane between the test and standard specimens corresponding to a certain time is measured, then the coefficient of thermal diffusivity of the test specimen can be computed. It takes about 30 seconds for the measurement and will yield a result with an estimated accuracy of about 3%. A.

536.21

6092. MATRIX ANALYSIS OF HEAT TRANSFER PROBLEMS. L.A.Pipes.
J. Franklin Inst., Vol. 263, No. 3, 195-206 (March, 1957).

This paper presents a method of analysis of heat conduction problems in solids based on matrix algebra. Use is made of the analogy that exists between the thermal problem and the flow of electricity in an electrical transmission line. It is shown that the use of matrix algebra greatly facilitates the calculation of transient and periodic heat flow in composite solids. A.

536.21 : 537.311.33

6093. THERMAL AND ELECTRICAL RESISTIVITY OF TELLURIUM AT LOW TEMPERATURES.
G.Fischer, G.K.White and S.B.Woods.
Phys. Rev., Vol. 106, No. 3, 480-3 (May 1, 1957).

Measurements are reported of the electrical and thermal resistivity between 2°K and room temperature of high-purity tellurium rods prepared by zone-refining. The maximum thermal conductivity in the case of a single crystal of 3 mm diameter is about 10 watts/cm deg at 4°K; analysis of the measurements suggests that in the specimens used the thermal conductivity — due predominantly to lattice waves — is limited by scattering at grain boundaries or dislocations for temperatures below 4°K and at higher temperatures (~ 100°K) by phonon–phonon interaction. The absence of an exponential "umklapp" region may be explained by the presence of many isotopes in tellurium. A.

536.21 : 548.7 : 539.155.2

6094. THE THERMAL CONDUCTIVITY OF DIELECTRIC CRYSTALS: THE EFFECT OF ISOTOPES. R.Berman, E.L.Foster and J.M.Ziman.
Proc. Roy. Soc. A, Vol. 237, 344-54 (Nov. 6, 1956).

Measurements of the thermal conductivity of TiO_2, KCl, LiF and of three types of diamond below room temperature are reported. Although the first three crystals were very pure there are great deviations from the form of conductivity curve predicted by Peierls for perfect crystals. A consideration of these and other results suggests that the conductivity of many crystals which have been measured is limited by the existence of more than one isotopic species of the chemical elements involved. These give rise to irregularities in the arrangement of atomic mass in the crystals and are a source of phonon scattering. A theory of this effect is given and is compared with the experimental results for the nine substances for which there are sufficient data. The agreement is satisfactory; only for diamond does it appear necessary in invoke impurities as well as isotopes to explain the observed conductivity. A.

536.212

6095. ON THE THEORY OF THERMAL CONDUCTIVITY OF PURE METALS AT LOW TEMPERATURE. P.G.Klemens.
Progr. theor. Phys., Vol. 16, No. 2, 154-6 (Aug., 1956).

The derivation of thermal conductivity requires the solution of an integral equation. Approximate solutions of varying degree of accuracy were put forward by the present author and by others. In this note the merits of the different solutions are discussed. R.Eisenschitz

536.23 : 541.127

6096. HEAT TRANSFER IN CHEMICALLY REACTING MIXTURES. I. J.O.Hirschfelder.
J. chem. Phys., Vol. 26, No. 2, 274-81 (Feb., 1957).

If a chemically reacting mixture is confined between two parallel plates, one hot and the other cold, the temperature and the chemical composition at a point, as well as the over-all heat flux, depend upon the rates of both the homogeneous reactions in the gas phase and the heterogeneous reactions on the surfaces. However, if the reaction rates are fast in either the forward or the reverse direction, the assumption of local chemical equilibrium (which is equivalent to the thermodynamics of irreversible processes) is found to be very good. Under such conditions the heat conductivity behaves as though the reacting gas mixture were a pure substance with an effective coefficient of thermal conductivity. A simple equation is given for this effective coefficient of thermal conductivity. Detailed examples are given for a unimolecular rearrangement $A \rightleftharpoons B$ and for the dissociation of oxygen, $O_2 \rightleftharpoons 2O$. The analysis applies equally well to liquid and to gaseous mixtures. A.

536.23 : 541.127

6097. HEAT CONDUCTIVITY IN POLYATOMIC OR ELECTRONICALLY EXCITED GASES. II. J.O.Hirschfelder.
J. chem. Phys., Vol. 26, No. 2, 282-5 (Feb., 1957).

The usual Eucken equation for the heat conductivity of a molecule with internal degrees of freedom is derived and improved. In the improved form the correction to the coefficient of thermal conductivity for the internal degrees of freedom of the molecule is given by the factor $0.115 + 0.354\ C_p/R$. With the help of Pt I (preceding abstract) it is proved that this approximation is valid only if the electronic states are not metastable and if the coefficients of diffusion of all the molecular quantum states are equal. The metastable electronic species should lead to anomalously large coefficients of thermal conductivity, whereas the usual excited electronic states, because of their gigantic size, should give a much smaller contribution to the coefficient of thermal conductivity than would be expected on the basis of the Eucken assumption. A.

536.24

6098. ON A PROBLEM OF THE TRANSFER OF HEAT BY SHIFTING A SOLID. M.Cotte.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 116A-120A (Nov., 1956). In French.

The cooling of an infinitely long homogeneous circular cylinder emerging with velocity v from a furnace where it is maintained at temperature T_0 and entering a liquid bath maintained at temperature θ_0 is studied mathematically. For very small values of v convection is unimportant; for very large values of v the longitudinal conduction is negligible, the temperature in the section perpendicular to the axis of the cylinder at the point of exit from the furnace is sensibly T_0 and the temperature distribution at some distance from the point of exit is deduced easily from the cooling of a cylinder which initially at T_0 is put in a bath at θ_0. For the case of a cylinder surrounded by a collar of different thermal conductivity and specific heat, an approximate expression for the temperature along the axis is derived using a similar procedure to that for the cylinder alone. S.Weintroub

536.24

6099. THE TURBULENT BOUNDARY LAYER OF AN INCOMPRESSIBLE FLUID ON A POROUS WALL. L.E.Kalikhman.
Zh. tekh. Fiz., Vol. 25, No. 11, 1957-64 (1955). In Russian.

An approximate solution of the problem of sucking or blowing in of fluid through a porous wall is given. It may be utilized to reduce friction, maintain continuity of flux, reduce the heat transfer or for protection against high temperature. The main parameter of the problem is "the blowing-in intensity". With its increase the thickness of the boundary layer is increased, the thermal flux to be extracted to maintain a given temperature and the temperature of the wall are reduced, especially when the heat of evaporation is utilized. Experiments confirm the simple theoretical formulae for the heat transfer and thermal resistivity of the porous wall. M.W.Makowski

536.24

6100. REMARKS ON THE PAPER OF L.E.KALIKHMAN "THE TURBULENT BOUNDARY LAYER OF AN INCOMPRESSIBLE FLUID ON A POROUS WALL". L.D.Berman.
Zh. tekh. Fiz., Vol. 26, No. 11, 2604-6 (1956). In Russian.

Criticisms: (a) The different specific heats and densities of a fluid and an evaporated cooling vapour are considered for heat transfer through the wall but not in the boundary layer. (b) The

curves for different parameters are drawn for the value of "the blowing-in intensity" equal to zero when the turbulent boundary layer is not yet formed. (c) The transverse flux must be defined by an additional hydrodynamic criterion. M.W.Makowski

536.244 : 533.6.011

6101. SOME CONSIDERATIONS REGARDING THE METHODS OF EVALUATING THE HEAT EXCHANGE AND HYDRAULIC RESISTANCE FOR A HIGH-VELOCITY GAS FLOW. P.V.Dvornichenko.
Zh. tekh. Fiz., Vol. 26, No. 7, 1571-8 (1956). In Russian.

Studies an equation of the type $\Delta T/\theta = un\xi/2D$, where ΔT is the gradient of the temperature experienced by the conduit walls along the gas flow (depending only on the conditions of the heat exchange), θ is the mean logarithmic temperature head, calculated from T, u is the ratio of the cross-section perimeter of the heat-emitting part of the wall to the entire perimeter, n is the ratio of the coefficients of heat transfer and heat emission, ξ is the coefficient of resistance, l is the length of the constant-section conduit, and D is the hydraulic diameter of the conduit (cf. Dvornichenko, Zh. tekh. Fiz., Vol. 23, 323, 1953). It is shown that this equation, which gives the variations of T in a forced flow with heat exchange as a function of ξ, is similar to the equation relating the criteria of kinematic and dynamic analogy. The question is posed whether the T-fields possess regions of self-similarity with regard to the Pe and Re criteria. It is shown that variations of T can be estimated by means of ξ even in cases when the main relationship of the hydrodynamical theory of heat exchange appears to be no longer valid. F.Lachman

536.245

6102. INSULATING PROPERTIES OF SHEET ASBESTOS PAPER. W.Noll.
Amer. J. Phys., Vol. 25, No. 2, 118-19 (Feb., 1957).

Gives results of power input required to maintain a galvanized can at various temperatures (a) with can bare, (b) with layers of asbestos paper around can. Generally with air-filled can one layer of asbestos increases heat losses by 25% to 60% and eight layers are required to reduce losses to the same level as with the bare can. The results with an oil-filled can are similar. F.E.Hoare

536.252 : 532.5 : 538.3

6103. EXPERIMENTS ON THE INHIBITION OF THERMAL CONVECTION BY A MAGNETIC FIELD. Y.Nakagawa.
Proc. Roy. Soc. A, Vol. 240, 108-13 (April 24, 1957).

Experiments on the magnetic inhibition of thermal convection in horizontal layers of mercury heated from below are described. A large $36\frac{1}{2}$ in. cyclotron magnet reconditioned for hydromagnetic studies was used in these experiments. By using layers of mercury of depth 3 to 6 cm and magnetic fields of strength 500 to 8000 gauss, it has been possible to determine the dependence of the critical Rayleigh number for the onset of instability on the parameter Q_1 ($= \sigma H^2 d^2/\pi^2 \rho\nu$, where H denotes the strength of the field, σ the electrical conductivity, ν the coefficient of kinematic viscosity, ρ the density and d the depth of the layer) for Q_1 varying between 40 and 1.6×10^6. The experiments fully confirm the theoretical relation derived by Chandrasekhar. A.

536.252 : 538.66

6104. EXPERIMENTS ON THE EFFECT OF INHOMOGENEITY AND OBLIQUITY OF A MAGNETIC FIELD IN INHIBITING CONVECTION. B.Lehnert and N.C.Little.
Tellus, Vol. 9, No. 1, 97-103 (Feb., 1957).

Two experiments are described on the inhibition of convection in a magnetic field. In the first experiment a layer of mercury is placed in an inhomogeneous magnetic field and heated from below. Photographs show convection where the field is weak, but indicate no motion where the field is strong. The boundary between these two regions corresponds to a critical magnetic field in agreement with current theory. The boundary is well defined showing that the onset of convection is sensitive to variations in the magnetic field. In the second experiment with a homogeneous field, varied in direction from vertical to horizontal, it is the vertical component which controls the onset of motion. A strong horizontal field does not inhibit convection but causes motion in narrow cells elongated in the direction of the field. A.

536.252

6105. TRANSIENT THERMAL CONVECTION ABOUT A HORIZONTAL CYLINDER. G.A.Ostroumov.
Zh. tekh. Fiz., Vol. 26, No. 12, 2720-30 (1956). In Russian.

Experiments are made with liquid (water, oil, alcohol) in a container where convection is brought about by means of a horizontal, electrically heated wire. Three sets of experiments are made: photographs of the pattern of flow, made visible by suspended aluminium powder; photographs of the propagation of temperature gradients, made visible by a kind of Schlieren apparatus combined with a stroboscope oscillographic measurements of the resistance; and, accordingly, temperature of the heated wire. Stationary distribution of velocity and temperature being known, experiments are concerned with the time between the onset of convection and the time when stationary conditions are reached. Making use of the hydrodynamical theory, experimental results are used for calculating parameters which are characteristic for transient convection of heat. R.Eisenschitz

536.253 : 551.511

6106. CONVECTION FROM THE EARTH'S SURFACE. C.H.B.Priestley.
Proc. Roy. Soc. A, Vol. 238, 287-304 (Jan. 8, 1957).

The non-linear temperature profile which obtains in the lowest 20 or 30 m over heated ground allows convection plumes, once formed, to maintain themselves in existence without any preferred heat supply. These plumes should form in general as elongated strips oriented downwind, their average section becoming more nearly circular as the negative Richardson number, $|Ri|$, increases. The heat flux H from a large area, by the agency of plumes of this type, is shown to satisfy the theoretical law (Priestley, 1954) of free convection,

$$H \propto \rho c_p \left(\frac{g}{T}\right)^{\frac{1}{2}} z^2 \left|\frac{\partial T}{\partial z} + \Gamma\right|^{\frac{3}{2}},$$

with a constant of proportionality which conforms to the observed value (T is the temperature at height z and Γ the adiabatic lapse rate). The observed validity of the above law in conditions of quite appreciable wind is at the same time explained. The value $-Ri = 0.011$ is deduced from theory as indicative of that at which free convection should begin to compete with forced convection as an effective agent of heat transfer, and it should become dominant at a value not many times greater. This supports the indications from earlier experiments. Various other lines of evidence confirm the reality of the plume models. A.

536.421

6107. THE P-T-x PHASE DIAGRAMS OF THE SYSTEMS In—As, Ga—As AND In—P. J.van den Boomgaard and K.Schol.
Philips Res. Rep., Vol. 12, No. 2, 127-40 (April, 1957).

For the compounds InAs, GaAs and InP the phase relations solid—liquid—vapour have been determined. InAs has a maximum melting point of $943 \pm 3^\circ$C at an arsenic pressure of 0.33 atm. GaAs has a maximum melting point of $1237 \pm 3^\circ$C at an arsenic pressure of 0.9 atm. For InP the maximum melting point is estimated to lie at $1062 \pm 7^\circ$C at a phosphorous pressure of approximately 60 atm. A.

536.421.4 : 539.155.2

6108. THE EQUILIBRIUM DISTRIBUTION OF LIGHT AND HEAVY WATERS IN A FREEZING MIXTURE. J.C.Posey and H.A.Smith.
J. Amer. Chem. Soc., Vol. 79, No. 3, 555-7 (Feb. 5, 1957).

The equilibrium distribution of the deuterium content of a mixture of light and heavy water between the solid and liquid phases has been determined. The deuterium concentrates in the ice phase. The separation factor, α, in solutions containing approximately 18 mole % of the total hydrogen as deuterium was found to be 1.0211 ± 0.0007. A.

536.422 : 54

6109. EVAPORATION OF METAL CRYSTALS. J.P.Hirth and G.M.Pound.
J. chem. Phys., Vol. 26, No. 5, 1216-24 (May, 1957).

A mechanism for vaporization of solid metals involving monatomic ledges on metal crystal surfaces is deduced, and an equation is derived for evaporation rate in terms of the dynamics of these ledges. It is shown that crystal edges are a ready source for monatomic ledges. The limiting expression for the vaporization coefficient of large, perfect crystals is given as a function of pressure and temperature by $\alpha = \frac{2}{3}(p/p_e) + \frac{1}{3}$, where p_e is the equilibrium vapour pressure. Various predictions of this theory are compared with available experimental results. A.

536.423.15 : 536.46

6110. APPARATUS FOR THE MEASUREMENT OF VAPOR PRESSURE AND IGNITION OR DECOMPOSITION TEMPERATURE AT PRESSURES ABOVE ATMOSPHERIC. A.G.Whittaker.
Rev. sci. Instrum., Vol. 28, No. 5, 360-4 (May, 1957).

An apparatus is described which can be used at pressures up to 4000 lb/in^2. The measurements can be made rapidly and under conditions simulating the combustion of liquids in an inert atmosphere

Vapour pressure data on ethyl nitrate and 2-nitropropane are presented, along with data on the decomposition temperature of triethyleneglycol dinitrate, metriol trinitrate-triacetin, and gem-dinitropropane. A.

536.424.1

6111. ON THERMAL HYSTERESIS OF TRANSFORMATIONS IN SOLIDS. M.J.Sparnaay.
Philips Res. Rep., Vol. 11, No. 5, 400-9 (Oct., 1956).

A simple order–disorder theory for the qualitative understanding of hysteresis phenomena is discussed. The essential feature is the introduction of an element of asymmetry into a zeroth-order treatment. A.

536.424.1

6112. AN INVESTIGATION ON THE ALLOTROPIC TRANSFORMATION $\alpha \rightleftharpoons \beta$ Zr BY MEANS OF AN ELECTRON EMITTER. A.P.Komar and V.N.Shrednik.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 184 (1957). In Russian.

Although in the Müller's emitter with a Zr point, used in the investigation, the pressure of residual gases was $<10^{-8}$ mm Hg, it was not possible to obtain a picture of electron emission with a smooth-surface point, such as can be obtained with a W point. The edges of the small crystals, both of the hexagonal close-packed α-Zr and of the cubic body-centred β-Zr, were always well discernible. For β-Zr, the protrusion of the {001} and {122} faces is explained by the incorporation of N atoms from the residual gases. The methods used to purify the surface are described. The $\alpha \rightarrow \beta$ transformation was not strictly reversible, since the orientation of the secondary α-Zr crystal was sometimes different from that of the original (primary) crystal. These differences were, however, in agreement with the relationship found by Burgers (1934). F.Lachman

536.461

6113. LATENT ENERGY OF FLAMES. E.Jones.
Nature (London), Vol. 179, 581-2 (March 16, 1957).

A study of the impact of a flame on the closed end of a pipe with piezoelectric gauges has shown that high-speed flames produce a mechanical effect similar to that of a projectile. It is suggested that this is the cause of knock in internal combustion engines, and that it is connected with the sudden release of energy when the flame is extinguished at the walls. R.C.Murray

536.461

6114. A CONTRIBUTION TO FLAME THEORY. G.Klein.
Phil. Trans. A, Vol. 249, No. 967, 389-415 (1957).

This is a mathematical treatment, in two parts, of the theory of flame propagation. In the first part, the reaction $A \rightleftharpoons B$ is considered for a one-dimensional flame, using binary diffusion coefficients but neglecting radiation and thermoeffects of diffusion. Solution is achieved in two stages, first by successive approximations and then by perturbation methods. In the second part, the treatment is extended to idealized special flames and then to the general case. Simplifying assumptions about diffusion coefficients, etc., are used and then corrections of departures due to failure of the assumptions are made by perturbation methods. A.G.Gaydon

536.48

6115. PHYSICS OF LIQUID HELIUM. D.F.Brewer.
Nature (London), Vol. 179, 79-82 (Jan. 12, 1957).

Report of a one-day discussion meeting of the Low Temperature Group of the Physical Society (London) on November 2nd 1956. The subjects considered and the main contributors were: Measurements of specific heat (O.V.Lounasmaa and R.W.Hill); Observations of the osmotic pressure of He^3–He^4 mixtures (H.London and E.Mendoza; D.H.N.Wansinck); Theory of liquid helium based on the many-atom Hamiltonian (H.N.V.Temperley; R.Eisenschitz); Theory of surface excitations (C.G.Kuper); Experiments on the flow through narrow channels (D.C.Champerney); Measurement of thickness of helium films, either formed from the saturated vapour or in contact with the liquid (L.C.Jackson); Measurement of absorption of sound (K.Dransfeld, J.A.Newell and J.Wilks); Viscosity of liquid helium as derived from measurements of subcritical heat flow (D.O.Edwards); Experiments on supercritical heat flow and their interpretation (D.F.Brewer); Experiments on propagation of sound in uniformly rotating helium II and their quantitative interpretation in terms of mutual friction (W.F.Vinen); Experiments and theory of angular acceleration and retardation of helium II (H.E.Hall). In the present report these contributions are briefly reviewed. R.Eisenschitz

536.48 : 539.11

6116. UNIFIED THEORY OF INTERACTING BOSONS. E.P.Gross.
Phys. Rev., Vol. 106, No. 1, 161 (April 1, 1957).

A method is outlined which is supposed to apply to the calculation of the energy spectrum of helium in the solid and in the liquid state. The equations of motion for the quantized amplitudes are at first solved for classical amplitudes; from the solutions inferences are made regarding the solution of the original problem. R.Eisenschitz

536.48 : 536.7

6117. THERMODYNAMIC PROPERTIES OF LIQUID HELIUM THREE. VAPOR PRESSURES BELOW 1°K. S.G.Sydoriak and T.R.Roberts.
Phys. Rev., Vol. 106, No. 2, 175-82 (April 15, 1957).

For earlier part, see Abstr. 6987 (1955). Vapour pressures of liquid He^3 have been measured between 0.45° and 1.0°K. Temperatures were measured by the paramagnetic susceptibility of either ferric ammonium or chrome methylamine alum. The salts were calibrated above 1°K against He^3 vapour pressures using the data of Abraham, Osborne, and Weinstock and the He^4 temperature scales of Clement (55E) and of van Dijk and Durieux (L55). The data obtained with the two salts were in good agreement with each other and indicate no preference between the two He^4 scales. In order to fit the data by a simple equation over the entire temperature range, explicit account had to be taken of the effect on the vapour pressure of the variation of the spin entropy, S_σ. An equation valid between the critical point and 0°K is

$$\ln p_{mm} = 2.5 \ln T_E + i_0 - (1/RT) \int_0^T S_\sigma dT -$$

$$- 2.53853/T_E - 0.20644T_E + 0.07728T_E^2 - 0.00919T_E^3,$$

where i_0 is the vapour pressure constant, 5.31733, and the subscript E designates use of the 55E scale throughout the calibration and subsequent equation fitting. By this equation the latent heat at absolute zero is 5.044 cal/mole. Between 0.25°K and the critical point, 3.327°K, the entropy integral is fitted by the empirical equation, $(1/RT) \int_0^T S_\sigma dT = 0.5020 + 0.1786 \ln T - 0.00912T^2$. A.

536.48

6118. THE ROTATION OF LIQUID HELIUM II. I. EXPERIMENTS ON THE PROPAGATION OF SECOND SOUND IN UNIFORMLY ROTATING HELIUM II. H.E.Hall and W.F.Vinen.
Proc. Roy. Soc. A, Vol. 238, 204-14 (Dec. 18, 1956).

An experimental investigation of the propagation of second sound in uniformly rotating resonators filled with liquid helium II has been made. It is found that in the uniformly rotating liquid the velocity of the second sound is not changed by more than 0.1%, but there is an excess attenuation which is, except near the λ-point, proportional to the angular velocity ω, independent of second-sound amplitude, and independent of frequency in the range 1.5 to 4.5 kc/s. These results are described phenomenologically by a mutual friction force $B(\rho_s\rho_n/\rho)\,\omega(\vec{v}_s - \vec{v}_n)$ per unit volume in the two-fluid model. The constant B is of order unity for second sound propagated at right angles to the axis of rotation; it is smaller by a factor of at least 5 when the second sound is propagated parallel to the axis of rotation. It is suggested that the mutual friction in rotating helium may contain a component perpendicular to $(\vec{v}_s - \vec{v}_n)$, and that there should be no mutual friction in an irrotational circulation. Experiments to verify these predictions are proposed. A.

536.48

6119. THE ROTATION OF LIQUID HELIUM II. II. THE THEORY OF MUTUAL FRICTION IN UNIFORMLY ROTATING HELIUM II. H.E.Hall and W.F.Vinen.
Proc. Roy. Soc. A, Vol. 238, 215-34 (Dec. 18, 1956).

A discussion is given of models for the rotation of helium II involving regions of concentrated vorticity, and it is shown thermodynamically that an arrangement of vortex lines is energetically perferable to an arrangement of vortex sheets. It is suggested that such models exhibit the property of mutual friction, owing to the possibility of collisions between normal fluid excitations and the regions of concentrated superfluid vorticity; the observed anisotropy of this mutual friction (Pt I of this paper) is consistent only with a vortex-line model, so that the theoretical decision in favour of this model is confirmed by experiment. A detailed calculation of the magnitude and temperature-dependence of this mutual friction is given for the quantized vortex-line model of Onsager (1949) and Feynman (1955). The vortex lines are treated as classical vortex

lines belonging entirely to the superfluid. The force of mutual friction arising from the collision of rotons with these lines is calculated in terms of the roton-line collision diameter $\bar{\sigma}$, taking into account a tendency for the lines to drag the gas of excitations (i.e. the normal fluid) in their vicinity, and a transverse motion of the lines due to the Magnus effect. The calculated mutual friction contains two components: one parallel to, and one perpendicular to , $(\vec{v}_s - \vec{v}_n)$. The magnitude of the former component agrees well with the experimental results if $\bar{\sigma}$ is taken to be about 10 A. The agreement between theory and experiment confirms that the normal fluid is dragged by the lines, and shows that the spacing of the lines must be close to the theoretical value given by Feynman; but it provides no evidence for or against a motion of the lines due to the Magnus effect. A rough value for $\bar{\sigma}$ is calculated in an appendix, and shown to agree as well as can be expected with the value derived from experiment. A.

536.48

6120. MUTUAL FRICTION IN A HEAT CURRENT IN LIQUID HELIUM II. I. EXPERIMENTS ON STEADY HEAT CURRENTS. W.F.Vinen.
Proc. Roy. Soc. A, Vol. 240, 114-27 (April 24, 1957).

Experiments have been carried out on the conduction of heat through helium II in channels of large rectangular cross-section (~ 2 x 6 mm) for small heat-current densities. The observed relationship between temperature gradient and heat-current density can be interpreted phenomenologically in terms of the Gorter–Mellink (1949) mutual friction force, $F_{sn} \cong A\rho_s\rho_n(v_s - v_n)^3$ per unit volume, in the two-fluid model, and observed values of A have been found to agree fairly well with those deduced from earlier measurements. Evidence is presented to show that the magnitude of the mutual friction is determined entirely by the value of $(v_s - v_n)$, independently of the boundary conditions imposed on the flow. A study of the propagation of second sound across the heat currents has shown that, while the presence of the heat current leads to no observable change in the velocity of the second sound, it does lead to an attenuation; the attenuation is linear and approximately proportional to the square of the heat-current density. This behaviour can be described phenomenologically in terms of the two-fluid model, if it is assumed that, in the presence of both a steady heat current and a second-sound wave, the Gorter–Mellink mutual friction must be generalized to the form $\vec{F}_{sn} = A\rho_s\rho_n\vec{U}^2\vec{u}$, where $\vec{u}$ is the instantaneous relative velocity between the two fluids and $\vec{U}$ is the time-average of this relative velocity. This result shows that in the presence of a steady heat current one or both of the fluids must become modified in some way, and that an essentially linear mutual friction is associated with this modification. Observation of changes in the attenuation of second sound provides a more sensitive method of measuring mutual friction than does the observation of temperature gradients, and it has been shown by the former technique that in the channels used in the present work there is a critical heat current below which the mutual friction is either absent or very small. A.

536.48

6121. MUTUAL FRICTION IN A HEAT CURRENT IN LIQUID HELIUM II. II. EXPERIMENTS ON TRANSIENT EFFECTS. W.F.Vinen.
Proc. Roy. Soc. A, Vol. 240, 128-43 (April 24, 1957).

It was shown in Pt I that, when helium II is carrying a steady heat current on which is superimposed a second-sound wave, the mutual friction acting between the two fluids (the Gorter–Mellink force) is of the form $G(\vec{v}_s - \vec{v}_n)$, where $(\vec{v}_s - \vec{v}_n)$ is the instantaneous relative velocity between the fluids, and the factor G is proportional to the square of the time average of this relative velocity. The present paper describes some experimental studies that have been made of the manner in which G changes when the heat current in a wide (~ 2 mm) channel is suddenly changed from one steady value to another; the changes in G have been observed as changes in the attenuation of second sound, and, where possible, as changes in the temperature gradient in the helium. It has been found, for example, that, when a steady supercritical heat current is suddenly switched on in initially undisturbed helium, G rises to its equilibrium value only after a delay time which is of the order of 1 sec, and that, when the heat current is removed, a non-zero value of G persists for at least 30 sec. The results indicate that the Gorter–Mellink force is probably associated with turbulence in the superfluid. It is suggested that the force may therefore be due fundamentally to the presence in the superfluid of motions for which curl $\vec{v}_s \neq 0$, and it is recalled that experimental evidence in favour of this view has been provided by the recent discovery that a mutual friction acts in helium that is simply in a state of uniform rotation. A.

536.48

6122. THERMODYNAMIC PROPERTIES OF He^3. V.S.Nanda and S.K.Trikha.
Progr. theor. Phys., Vol. 16, No. 3, 254-6 (Sept., 1956).

As a model of the liquid the authors consider a lattice of He^3 atoms in the interstices of which single He^3 atoms are free to move. The ratio of "free" and "lattice" atoms is an adjustable paramter. Agreement with experimental specific heat and entropy is good. R.Eisenschitz

536.48

6123. FURTHER CONSIDERATIONS REGARDING He^3–He^4 MIXTURES. S.M.Bhagat.
Proc. Nat. Inst. Sci. India A, Vol. 22, No. 5, 273-84 (1956).

A constant potential model with a generalized energy spectrum has been applied to a study of some of the observed properties of He^3–He^4 mixtures. The vapour pressure and the distribution coefficient, especially for relatively low concentrations (~ 10%), are found to agree well with experiment. Further, it is shown that the partial vapour pressure of He^3, as a function of temperature, has a break at the λ-line, in agreement with experiment as well as the thermodynamic predictions of de Boer and Gorter (1952). This is also found to be the case with the total vapour pressure as a function of concentration. A.

536.48

6124. MEASUREMENT OF SATURATED VAPOUR PRESSURES OF He^3–He^4 MIXTURES AT HIGH CONCENTRATIONS OF He^3. V.P.Peshkov and V.N.Kachinskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 720-1 (1956). In Russian.

Measurements are made of the saturation pressures of gaseous mixtures of known concentrations and of the densities of the liquid and vapour phases. The concentration in the liquid phase is approx. 93.6, in the vapour phase 97.0 and 94.0 mole %. As a result the pressure isotherms at 1.5 , 1.7 and 1.9°K are plotted against the concentration in the liquid and vapour phases. Agreement with known data at lower concentrations is satisfactory. R.Eisenschitz

536.48

6125. HELIUM FILM FLOW BELOW 1°K. G.R.Hebert, K.L.Chopra and J.B.Brown.
Phys. Rev., Vol. 106, No. 3, 391-3 (May 1, 1957).

The critical transfer rate of the helium II film was measured at temperatures between 0.3°K and the lambda point. Filling rates of a small beaker enclosed in a sealed glass capsule which could be tipped as a whole were studied. A technique was developed whereby the glass capsule could be sealed off at room temperature with 750 lb/in² of helium gas, sufficient to provide enough liquid within the capsule at the low temperatures. It was found that the rate of flow at 0.3°K rises 25% above the value at the flat minimum near 1°K, in approximate agreement with the results of Ambler and Kurti A

536.483

6126. SMALL INDUCTION MOTOR AND BEARINGS FOR OPERATION IN LIQUID HELIUM. R.J.Donnelly.
Rev. sci. Instrum., Vol. 28, No. 5, 351-3 (May, 1957).

Small Teflon and Kel-F bearings have been developed which operate in the temperature range below 80°K. They have been used to modify a commercially available induction motor for operation directly in a bath of liquid helium. A

536.511

6127. MERCURY-IN-QUARTZ THERMOMETERS FOR VERY HIGH ACCURACY. H.Moreau, J.A.Hall and V.M.Leaver.
J. sci. Instrum., Vol. 34, No. 4, 147-54 (April, 1957).

Experiments have shown that mercury thermometers of fused quartz do not show zero changes exceeding one or two hundredths of a degree after heating to 600°C, while heating for a month at 100°C did not produce a change greater than 0.001 deg C. Thermometers and observing equipment have been designed to take advantage of this stability, and observations on a thermometer ranged 0° to 28°C show a reproducibility of reading to within ±0.0007 deg C over a period of twelve months. A

536.53

6128. THERMISTOR THERMOMETER BRIDGE: LINEARITY AND SENSITIVITY FOR A RANGE OF TEMPERATURE. K.S.Cole
Rev. sci. Instrum., Vol. 28, No. 5, 326-8 (May, 1957).

The balance point of a Wheatstone bridge with a slide wire for ratio arms is a nearly linear function of the temperature of a thermistor in a third arm, the maximum errors of a linear calibration are made equal and proportional to the cube of the temperatur

range, and the off-balance sensitivity is nearly constant for a considerable temperature range. For a small thermistor with a 2000 ohm resistance at 25°C, the slide position of a linear potentiometer is proportional to the thermistor temperature ±0.5 deg. C, and the deflection of a taut suspension pointer galvanometer is 20 ± mm/deg. C over the temperature range from 0°C to 50°C with a maximum thermistor temperature rise of 0.05 deg. C in still air. A.

536.621.1

6129. LOW TEMPERATURE MIXING CALORIMETER FOR LIQUIDS. J.Jeener.
Rev. sci. Instrum., Vol. 28, No. 4, 263-5 (April, 1957).

A technique is described for measuring the heat of mixing, excess volume, specific heat, and other thermodynamic properties of liquid systems at low temperature (e.g. CO, CH_4, A, Kr). Experiments are carried out at constant pressure, without any vapour phase in the calorimetric vessel. A.

536.621.2

6130. NERNST–MAGNUS TYPE CALORIMETER FOR THE MEASUREMENT OF HEAT CAPACITIES UP TO 1600°C. M.Olette.
C.R. Acad. Sci. (Paris), Vol. 244, No. 7, 891-4 (Feb. 11, 1957). In French.

The apparatus consists of an electrically heated furnace and an adiabatic copper-block calorimeter. Measurements are reported of the enthalpy of pure aluminium at 850° and 1227°C and the results differ by less than 0.03% from N.B.S. results. E.P.Wohlfarth

536.631 : 539.219

6131. THE ELECTRONIC HEAT CAPACITY OF A COPPER/3% ZINC ALLOY. J.A.Rayne and W.R.G.Kemp.
Austral. J. Phys., Vol. 9, No. 4, 569-70 (Dec., 1956).

There is a considerable difference between the electronic heat capacity of Cu and Cu/1%Cd. For a similar Zn alloy the difference in electronic heat capacity is much smaller. The large effect with the Cd alloy is due to the large lattice distortion connected with the Cd^{++} ions. C.A.Hogarth

536.631

6132. THE ATOMIC HEAT OF SAMARIUM FROM 2° TO 20° K. L.M.Roberts.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 434-5 (April, 1957).

Measurements of the atomic heat of Sm in the range 2° to 20°K show a sharp maximum at 13.6°K, in good agreement with a maximum observed in the magnetic susceptibility at 14°K. An approximate value of the entropy associated with the 13.6°K anomaly is calculated. A.J.Mee

536.631

6133. THE ATOMIC HEAT OF CERIUM BETWEEN 1.5° AND 20°K. D.H.Parkinson and L.M.Roberts.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 471-5 (May, 1957).

The specific heat of a specimen of cerium of face-centred cubic structure has been measured between 1.5° and 20°K and anomalous effects, expected as a result of the susceptibility measurements of Lock, have been found. The specific heat shows a marked maximum at 12.5°K, the magnitude of which increases with the number of times the specimen has been cooled. The anomaly is probably due to antiferromagnetism. A.

536.631 : 536.48

6134. THE SPECIFIC HEATS OF THREE PARAMAGNETIC SALTS AT VERY LOW TEMPERATURES.
A.H.Cooke, H.Meyer and W.P.Wolf.
Proc. Roy. Soc. A, Vol. 237, 395-403 (Nov. 6, 1956).

The specific heats of three paramagnetic salts, neodymium magnesium nitrate, manganous ammonium sulphate and ferric ammonium alum, have been measured at temperatures below 1°K using the method of γ-ray heating. The temperature measurements were made in the first instance in terms of the magnetic susceptibilities of the salts, the relation of the susceptibility to the absolute temperature having been determined for each salt in earlier experiments. The γ-ray heatings gave the specific heat in arbitrary units. The absolute values of the specific heats were found by extrapolating the results of paramagnetic relaxation measurements at higher temperatures. The measured specific heat of neodymium magnesium nitrate is compared with the value calculated from paramagnetic resonance data, and good agreement is found. A.

536.631 : 536.48 : 538.222

6135. THERMAL AND MAGNETIC PROPERTIES OF FERRIC METHYLAMMONIUM SULPHATE.
A.H.Cooke, H.Meyer and W.P.Wolf.
Proc. Roy. Soc. A, Vol. 237, 404-12 (Nov. 6, 1956).

The specific heat and magnetic susceptibility of ferric methylammonium sulphate have been measured at temperatures between 0.17 and 20°K. The specific heat has been analysed into a lattice contribution and a magnetic anomaly. It is shown that the magnetic contribution to the specific heat can be accounted for almost entirely by the Schottky anomaly due to the Stark splittings of the ground state of the Fe^{3+} ions, previously determined by Bleaney and Trenam (1954). The splittings are unusually large in this salt, with the result that the specific heat is very large at temperatures near 1°K, reaching a maximum value of 1.1 cal/mole at 0.33°K. The salt should therefore be useful for magnetic cooling experiments in which other substances are to be kept below 1°K for prolonged periods. A.

536.631

6136. THE LOW-TEMPERATURE (2 TO 4.2°K) SPECIFIC HEATS OF PALLADIUM–SILVER ALLOYS. F.E.Hoare and B.Yates.
Proc. Roy. Soc. A, Vol. 240, 42-53 (April 24, 1957).

The low-temperature, 2 to 4.2°K, specific heats of a series of nine palladium–silver alloys and the pure metals have been measured. From the results the variation with concentration of θ_D, the Debye temperature, and γ, the electronic heat coefficient, have been determined. According to the collective electron approach the height of the band at the Fermi level is proportional to γ. This enables an approximate band shape to be deduced on the assumption that alloying leaves the shape substantially unchanged. The band obtained in this way is considered in relation to earlier work on the magnetic susceptibilities of this alloy series. A.

536.631

6137. HEAT CAPACITY OF KCl. T.I.Kucher.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 152 (1957). In Russian.

The heat capacity is calculated between 10 and 270°K from the proper frequencies of KCl, allowing for the deformation of the lattice, and the differing masses of the K and Cl ions. The calculated values are compared with previously published measurements. R.F.S.Hearmon

536.633

6138. CONTRIBUTION TO THE MEASUREMENT OF THE SPECIFIC HEATS OF GASES. Huetz-Aubert.
J. Phys. Radium, Vol. 17, No. 10, 849-58 (Oct., 1956). In French.

Methods of calculating the specific heats of gases by measuring their isothermal and isentropic compressibilities are examined and the requirements necessary for accurate results discussed. A method of measuring the isentropic compressibility which satisfies these requirements is proposed in which the oscillations of a column of mercury in a U-tube containing the gas are measured. A self-maintaining experimental arrangement is described and the results obtained for various gases are compared with those of other workers. R.C.Glass

THERMODYNAMICS 536.7/.8

536.7

6139. SUFFICIENCY OF THE TOTAL ENERGY OF A SYSTEM IN EQUILIBRIUM FOR ESTIMATING ITS TEMPERATURE. B.Mandelbrot.
C.R. Acad. Sci. (Paris), Vol. 243, No. 23, 1835-8 (Dec. 5, 1956). In French.

By using more rigorous mathematics, an identity is proved to exist between the statistical sufficiency, and the fact that thermal equilibrium of an isolated system is independent of the initial temperature distribution and only dependent on the total energy. A new axiom is deduced, based on the theory of estimation of parameters, very analogous to the axioms of quantum theory, based on analysis of observations. C.Turner

536.7

6140. FLUCTUATIONS IN THE EXTERNAL REACTIONS OF A THERMODYNAMICAL SYSTEM. H.Wergeland.
K. Norske Vidensk. Selsk. Forhandl., Vol. 28, No. 1, 106-11 (1955).

Gibbs' fluctuation formula is applied to pressure fluctuations, both for fast and slow fluctuations, and a general formula is deduced, giving the pressure fluctuations as the difference between isothermal and isentropic tension coefficients. It is shown that Gibbs' formula can only be applied to reversible processes. C.Turner

536.7 : 541.64

THEOREM OF CORRESPONDING STATES FOR POLYMERS.
See Abstr. 5713

536.72

6141. THE FIRST LAW OF THERMODYNAMICS FOR A CONTINUOUS MEDIUM IN MASS MOTION. L.M.Grossman.
Amer. J. Phys., Vol. 25, No. 4, 257-61 (April, 1957).

The integral form of the conservation of energy for a continuous medium in motion is derived from the usual differential expression of the first law of thermodynamics. Various special cases of this relation are considered, and in particular it is shown that the invariance of the sum of kinetic energy, potential energy, and $e + \bar{p}/\rho$ may be written for arbitrary dissipative motions under certain definitions of the boundary conditions of the system. A.

ELECTRICITY 537

537.13 : 539.185 : 530.145

ANOMALOUS MAGNETIC MOMENTS OF NUCLEONS.
See Abstr. 5839

ELECTROSTATICS. DIELECTRICS 537.2

537.212 : 530.12

ELECTROSTATIC FIELDS IN JORDAN'S EXTENDED THEORY OF GRAVITATION. See Abstr. 5821

537.226.1

6142. ON THE THEORY OF POLARIZATION OF DIELECTRICS. M.I.Shakhparonov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 4, 815-17 (1957). In Russian.

537.226.1 : 532.13

6143. DIELECTRIC RELAXATION, VISCOSITY AND FREEZING. N.E.Hill.
Proc. Roy. Soc. A, Vol. 240, 101-7 (April 24, 1957).

It is shown that polar liquids may be divided into two classes according to whether or not the rotation of the dipoles is prevented by solidification. For liquids belonging to the first class, and having rigid molecules, an equation similar to Debye's can be used to relate the dielectric relaxation time and the viscosity. This equation does not involve the "molecular radius" which has always made the interpretation of Debye's equation uncertain, and it can, in consequence, be used to determine from the experimental results how the ratio of the microscopic to the macroscopic relaxation time (τ/τ') depends on the static dielectric constant. The theory has been applied to a number of organic liquids of rigid molecular structure, and indicates that the dependence of τ/τ' on the dielectric constant is best expressed by Powles's equation $\tau/\tau' = (2\epsilon_0 + \epsilon_\infty)/3\epsilon_0$. For liquids belonging to the second class no simple relation between dielectric relaxation time and viscosity can be expected, but it may be possible to relate the relaxation time in some way to the transition which occurs in the solid state, in which the freedom of dipole rotation is lost. A.

537.226.1.08

6144. CELL FOR THE DETERMINATION OF PRESSURE COEFFICIENTS OF DIELECTRIC CONSTANT AND LOSS OF LIQUIDS AND SOLIDS TO 10 000 P.S.I. D.W.McCall.
Rev. sci. Instrum., Vol. 28, No. 5, 345-51 (May, 1957).

A cell is described in which one can measure pressure coefficients of the dielectric constant and loss of liquids and solids to 10 000 lb/in^2. Data are reported for the liquids benzene, dioxane, and toluene to illustrate the use of the cell. Data are also reported for polyethylene-5% butyl rubber to illustrate the use of the cell for the measurement of solids. A.

537.226.2 : 621.3.015.5.029.5 : 621.315.618

6145. THE ELECTRICAL BREAKDOWN OF GASEOUS DIELECTRICS AT HIGH FREQUENCIES. R.R.T.Fatehchand.
Proc. Instn Elect. Engrs, Monogr. 242R, publ. June, 1957, 7 pp. To be republished in Part C.

The continuous-wave breakdown of air and an air/carbon tetrachloride mixture in uniform electric fields is examined, at frequencies between 3.5 and 30 Mc/s. The observations in air indicate that, if the pressure is reduced below atmospheric, the high-frequency breakdown voltage does not fall below the 50 c/s value until the amplitude of positive-ion oscillation has become much smaller than the gap width. This result is explained by a breakdown mechanism which depends both on positive-ion accumulation and on the variation of electron-ionization coefficient with electric field strength. Measurements by an air-stream method of a quantity related to pre-breakdown ionization in the gap appear to be consistent with the suggested breakdown mechanism. The h.f. measurements also exhibit the electron-diffusion type of breakdown, where a simple theoretical relationship must be satisfied for discharge initiation. A description is given of the effect of a small admixture of carbon tetrachloride vapour on the h.f. breakdown of air at a reduced pressure. The vapour concentration was insufficient to affect 50 c/s breakdown. Where the electron-diffusion type of breakdown is normally operative, the h.f. breakdown strength increases by up to 50% when the vapour is present. The increase appears to be caused by electron attachment to vapour molecules. A.

537.226.2

6146. DIELECTRIC PROPERTIES OF SOLID ALKYL POLYMETHACRYLATES. G.Offergeld.
Nature (London), Vol. 178, 1460-1 (Dec. 29, 1956).

A dispersion region starting near the temperature of transition to the rubbery state has been observed for a number of higher methacrylate polymers. Activation energies have been derived from the temperature variation of the frequency corresponding to maximum dielectric loss. The values of the activation energies suggest that orientation of dipolar side groups is involved, independently of the main polymer chains. K.W.Plessner

537.226.2

6147. INFLUENCE OF PRESSURE ON THE DIELECTRIC PROPERTIES OF ICE. R.Brill and P.Camp.
Nature (London), Vol. 179, 623-4 (March 23, 1957).

A pressure of 2 kg/cm^2 was applied between the electrode plates and the dielectric properties were observed as a function of time. No quantitative data are given, but it is suggested that the changes observed were due to alterations in the defect structure of the crystals. K.W.Plessner

537.226.2 : 621.3.017.143 : 621.315.612.6

6148. FURTHER EXPERIMENTAL INVESTIGATION OF THE DIELECTRIC LOSSES OF VARIOUS GLASSES AT LOW TEMPERATURES. J.Volger and J.M.Stevels.
Philips Res. Rep., Vol. 11, No. 6, 452-70 (Dec., 1956).

The results of loss measurements at low temperatures on a number of glasses are given. These are discussed qualitatively in connection with the glass structure. The importance of impurities in fused silica is shown. The influence of thermal treatment is also considered. Contrary to experience with quartz crystals, no effect of irradiation (formation of colour centres) upon the dielectric losses at low temperatures is found. A comparative survey of the various loss mechanisms found hitherto in the vitreous and crystalline states is given. A.

537.226.2

6149. DEPENDENCE OF ELECTRIC STRENGTH ON TEMPERATURE FOR CRYSTALS OF KBr AND KCl.
E.A.Konorova and L.A.Sorokina.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 143-4 (1957). In Russian.

Curves showing the dependence of electric strength on temperature are given for KBr (direct current and impulses of duration 10^{-2}, 10^{-4} and 10^{-6} sec) and KCl (direct current and impulses of 10^{-6} sec duration). The curves usually show a maximum strength at about 50° C, the maximum tending to become less pronounced as the duration of the impulses decreases. R.F.S.Hearmon

537.226.2

6150. TEMPERATURE HYSTERESIS OF THE DIELECTRIC CONSTANT OF $BaTiO_3$ MONOCRYSTALS. A.Misařová.
Czech. J. Phys., Vol. 6, No. 5, 527-9 (Oct., 1956). In Russian.

The curve of temperature dependence of the dielectric constant has sharp maxima at temperatures corresponding to the three known structural transitions of $BaTiO_3$ (Θ: +120° C; Θ_1: +10° C; Θ_2: −80° C). Heating the crystal to a high temperature shifts the positions of Θ and Θ_1 to higher temperatures and at the same time the temperature hysteresis of dielectric constant increases. Z.Krasucka

537.226.

6151. STRUCTURE AND DIELECTRIC PROPERTIES IN THE SYSTEM $BaTiO_3$–$MgTiO_3$. H.Pfisterer, W.Heywang and E.Ramisch.
Ber. Dtsch. Keram. Gesell., Vol. 33, No. 6, (1956). [Reprinted in Entwicklungsber. Siemens & Halske, Vol. 19, No. 4, Dec., 1956]. In German.

Between −20 and +140° C, the permittivity ϵ, and the variation of ϵ with temperature, in mixed crystals of $BaTiO_3$–$MgTiO_3$,

decrease as the percentage of $MgTiO_3$ is increased. The permittivity is also highly dependent on the amplitude of the applied voltage. The behaviour is discussed in relation to phase transitions indicated by microscopic and X-ray analysis. J.H.Mason

537.226.2

6152. THE THERMODYNAMIC THEORY OF FERROELECTRICS. I.A.Izhak.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 160-2 (1957). In Russian.

Comparison of experimental data obtained for polycrystals of $BaTiO_3$ in the paraelectric region with deductions of the thermodynamic theory shows that in this region the theory is applicable to polycrystalline $BaTiO_3$. Z.Krasucki

537.226.3

6153. DEBYE'S DIPOLAR ABSORPTION IN THE HERTZIAN SPECTRUM. I. LATTICE DEFECTS IN MINERAL COMPOUNDS. II. CAMPHOR AND FENCHONE, THIOPHEN AND PYRIDINE. M.Freymann and R.Freymann.
Cahiers de Phys., No. 74, 40-2 (Oct., 1956). In French.

Brief enumeration of problems which can be studied by this method, in particular its use as an analytical tool for identifying impurities in semiconductors and detecting the presence of isomers in organic compounds. See Abstr. 1197, 5073, 8762 (1956). J.Hawgood

537.226.31 : 536.4

6154. DIELECTRIC ABSORPTION AND PHASE CHANGE IN AN ALIPHATIC ESTER IN THE WAXY FORM. J.S.Dryden.
J. chem. Phys., Vol. 26, No. 3, 604-7 (March, 1957).

The dielectric absorption has been examined in an aliphatic ester, butyl stearate, when in the waxy, transcent form. The measurements reveal the existence of three phases with well-defined transition temperatures; thermal studies and X-ray powder photographs confirm the existence of the three phases. There are three absorption regions in each phase, one possessing a very high activation energy. The possible mechanisms of the absorptions are discussed briefly. A.

537.226.32

6155. NEW ELECTRETS FROM INORGANIC DIELECTRICS. A.N.Gubkin and G.I.Skanavi.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 140-2 (1957). In Russian.

It is shown that stable electrets can be obtained from polycrystalline inorganic dielectrics, such as the titanates of magnesium, calcium, bismuth, strontium, zinc, strontium–bismuth, from barium metatitanate, barium tetratitanate and from steatite. Results are presented giving the variation of the effective surface density of charge with time. Z.Krasucki

537.228 : 535.417

6156. NEW METHOD OF MEASURING DIRECTLY THE PIEZO-OPTIC EFFECT. APPLICATION TO QUARTZ. II. B.Vittoz.
Rev. Opt., Vol. 35, No. 8-9, 468-80 (Aug.-Sept., 1956). In French.

For Pt I, see Abstr. 349 (1957). The theory is given of the 3-beam interferometer and its component parts are fully described. Some results indicating the exact linearity of the piezo-optic effect of quartz are quoted. Reference is made to other possible uses of the interferometer. H.J.H.Starks

537.228.1 : 548.7

6157. ON THE EFFECT OF DIFFERENT KINDS OF RADIATION ON THE PROPERTIES OF PIEZO-QUARTZ AND VIBRATING CRYSTALS. F.Seidl.
Acta phys. Austriaca, Vol. 10, No. 3, 169-74 (1956). In German.

Some earlier work is reviewed; Laimböck (1928) observed a 34% increase in the piezoelectric constant, ϵ, of quartz irradiated with radium rays. Frondel (1946) noted that the natural frequency of quartz fell exponentially with radiation dose to a saturation value. This saturation value was independent of the kind of radiation, but varied from one sample to another by a factor of 20 or more. The author irradiated one of Laimböck's original samples (which initially had a very low ϵ) and obtained a further 6.6% increase of ϵ. Five other quartz samples were irradiated, but the increase of ϵ was barely outside the experimental error. Changes of colour and of frequency of oscillation are attributed to formation of colour centres by radiation. The reduction of natural frequency is not maintained, partly because the colour centres are short-lived and partly because the crystal is subjected to high mechanical strain. B.T.M.Willis

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.1

6158. ELECTRICAL RESISTANCE OF FERROMAGNETIC METALS. T.Kasuya.
Progr. theor. Phys., Vol. 16, No. 1, 58-63 (July, 1956).

In ferromagnetic metals an anomalous electrical resistance is observed which is characteristic of the magnetization and is additive to the ordinary electrical resistance. The origin of this anomalous electrical resistance has been discussed by several authors, but all such attempts do not seem to have satisfactorily explained this phenomenon either quantitatively or qualitatively. In this paper the anomalous electrical resistance is calculated from the standpoint of s–d interaction as developed by the author. The anomalous electrical resistance occurs because the exchange energy between the conduction and the unfilled inner shell electrons depends on the relative direction of the spins of the electrons, and this interaction is not periodic in finite temperatures. In numerical values as well as in the temperature dependence, the results are in good agreement with experimental results. A.

537.311.1

6159. ELECTRONIC CONDUCTION IN AgBr CONTAINING IMPURITIES AFTER IRRADIATION AT LIQUID HYDROGEN TEMPERATURES. L.Jung.
Z. Phys., Vol. 146, No. 4, 479-95 (1956). In German.

Crystals with both anion and cation impurity showed electronic dark conduction at liquid hydrogen temperatures after irradiation. Conductivity/temperature curves showed maxima and irreversible conductivity changes were observed on cooling again if these maxima were exceeded. The impurity governed the position of the maxima. A trap model is suggested and the reaction equations are solved in special cases. J.E.Caffyn

537.311.31

6160. ELECTRICAL RESISTIVITY OF Au_3Cu AT LOW TEMPERATURES. H.Sato.
Phys. Rev., Vol. 106, No. 4, 674-5 (May 15, 1957).

The electrical resistivity of Au_3Cu heat-treated for different lengths of time at 185°C was measured from liquid-helium temperature to room temperature. Although this alloy is anomalous in that the ordered state has a higher electrical resistivity than the disordered one, it was found that the annealed state has actually a lower resistivity than the quenched one at liquid-helium temperature. The Debye temperature of the ordered state is found to be lower than that of the disordered state and this fact is contrary to the case of Cu_3Au. A.

537.311.33

6161. CONDUCTION OF ELECTRICITY THROUGH ICE AND SNOW. I. DISCHARGE OF A CONDENSER THROUGH ICE CRYSTALS. R.Siksna.
Ark. Fys., Vol. 11, Paper 43, 495-510 (1957).

Measurements of the electrical conductivity of single crystals of ice parallel and perpendicular to the optic axis are made in the range −27°C to −2°C. The resistance of the specimens is found to depend on the previous electrical history suggesting either that an impurity is removed by the current or is introduced from the electrodes. J.E.Caffyn

537.311.33

6162. CONDUCTION OF ELECTRICITY THROUGH ICE AND SNOW. II. CURRENT THROUGH A CIRCUIT WITH ICE CRYSTAL INSERTED. R.Siksna.
Ark. Fys., Vol. 11, Paper 44, 511-28 (1957).

For Pt I, see preceding abstract. The d.c. conductivity is obtained from measurement of the current flowing through the crystal. The effect of electrode material, temperature, voltage and time on the conductivity is investigated. J.E.Caffyn

537.311.33

6163. CONDUCTION OF ELECTRICITY THROUGH ICE AND SNOW. III. CURRENT THROUGH SNOW AND DISTRIBUTION OF POTENTIAL IN A SNOW SANDWICH. R.Siksna and A.Metnieks.
Ark. Fys., Vol. 11, Paper 46, 567-73 (1957).

For Pt II, see preceding abstract. The potential distribution in snow used as a dielectric and its variation in time is measured under various conditions. J.E.Caffyn

537.311.33

6164. THE ELECTRICAL CONDUCTIVITY OF ICE. R.S.Bradley.
Trans Faraday Soc., Vol. 53, Pt 5, 687-91 (May, 1957).

The d.c. electrical conductivity κ of ice has been determined at 0 to -25°C, and is given by $\kappa = 23.4 \exp(-12\,300/RT)$ ohm^{-1} cm^{-1}. The results are discussed in terms of proton migration and semiconductor theory. A.

537.311.33

6165. REPORT OF THE MEETING ON SEMICONDUCTORS.
Publication of the Physical Society (1957) 153 pp.

This meeting was held by the Physical Society in collaboration with British Thomson-Houston Ltd., Rugby in April 1956. Abstracts of the papers will appear later.

537.311.33 : 541.57

6166. THE CHEMICAL BOND IN SEMICONDUCTORS.
E.Mooser and W.B.Pearson.
J. Electronics, Vol. 2, No. 4, 406-7 (Jan., 1957).

The group V elements As, Sb, Bi only exhibit semiconductivity when in the amorphous state, and the semiconducting properties result from the semiconducting bond concept previously proposed by the authors. C.A.Hogarth

537.311.33

6167. DEMONSTRATION OF ELECTRON AND HOLE INJECTION IN ALKALI HALIDES. H.N.Hersh and L.Bronstein.
Amer. J. Phys., Vol. 25, No. 5, 306-10 (May, 1957).

A simple experimental set-up, well adapted for demonstration purposes for the beginner and advanced student alike, vividly depicts current flow in insulators by holes or electrons. This is achieved by the trapping of carriers during electron or hole injection in alkali halides giving rise to striking colour changes due to the formation of colour centres. A.

537.311.33

6168. ON THE THEORY OF HOLES. II. NON-RADIATIVE TRANSITIONS. G.Helmis.
Ann. Phys. (Leipzig), Vol. 19, No. 1-2, 41-54 (1956). In German.

For Pt I see Abstr. 6626 (1956). The methods of analysis are further developed to deal with non-radiative transitions which are of importance in studies of luminescence, phosphorescence, and photoconductivity in solids. C.A.Hogarth

537.311.33 : 621.315.59

6169. THE DETERMINATION OF VOLUME AND SURFACE RECOMBINATION IN SEMICONDUCTORS.
W.Heywang and M.Zerbst.
Nachrichtentech. Fachber. (NTF), Vol. 5, 27-9 (1956). In German.

An analysis of the effects of volume lifetime (τ_v) and surface recombination velocity (s) on the decay of photoconductivity. It is shown that the effects can be assessed separately with a suitable experimental arrangement and values of τ_v and s for samples of high purity silicon are given. M.R.Hopkins

537.311.33 : 537.312.5

6170. STORAGE OF INJECTED CARRIERS AT SURFACES OF GERMANIUM. B.H.Schultz.
Philips Res. Rep., Vol. 12, No. 1, 82-96 (Feb., 1957).

The relative number of particles at the surface in the presence of an injection is calculated with the aid of standard space-charge theory. The effect of this "surface storage" on the relaxation of photoconductance is discussed. Measurements have been made of τ_{rel} of thin n- and p-type germanium rods as a function of their thickness in different atmospheres. The results are in qualitative agreement with the theory. For rods with large surface storage, τ_{rel} increases if the thickness is reduced and becomes very sensitive to the injection level. A.

537.311.33

6171. EXCESS NOISE IN N-TYPE GERMANIUM. J.J.Brophy.
Phys. Rev., Vol. 106, No. 4, 675-8 (May 15, 1957).

An experimental examination of excess noise in n-type single-crystal germanium has confirmed that the phenomenon behaves like conductivity modulation caused by carrier-density fluctuations. The magnitude and frequency spectrum of the carrier-density fluctuations, as measured by the Hall effect, yield good agreement with observed excess noise levels. Majority and minority carrier density fluctuations are correlated in such a way that the density varies percentagewise. It is shown experimentally that noise sources are distributed uniformly along the specimen length and that statistically independent volume elements are smaller than 10^{-8} cm^3. These results are independent of sample shape, resistivity, and surface treatment, which affect only the magnitude of the fluctuations. Results on samples with resistivities ranging from 1.5 to 35 ohm cm show an increase in fluctuations with resistivity. A.

537.311.33 : 538.66

6172. THE NERNST–ETTINGSHAUSEN EFFECT IN GERMANIUM. R.I.Bashirov and I.M.Tsidil'kovskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 10, 2195-9 (1956). In Russian.

Measurement of the temperature dependence of the Nernst-Ettingshausen effect permits the determination of (1) the temperature dependence of mobility of one kind of carriers in the intrinsic conduction range and (2) the dominant scattering mechanism at lower temperatures. Measurements were made on five specimens of n- and p-type Ge in the range 125 to 650°K. Resistivities varied from 0.01 to 48.5 ohm cm. From curves of the N.-E. field v. temperature, the hole mobility is deduced to vary as $T^{-2.4}$ in the intrinsic region. If simultaneous determinations of the Hall constant and conductivity are also made, the mobility ratio may also be deduced. A value of 2.2 at 550°K is found. J.B.Arthur

537.311.33

6173. AN INVESTIGATION OF THE IONIC CONDUCTIVITY OF KI:Tl PHOSPHORS. L.M.Shamovskiĭ, A.A.Dunina and M.I.Gosteva.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 4, 811-14 (1957). In Russian.

537.311.33

6174. TEMPERATURE DEPENDENCE OF ELECTRON-BOMBARDMENT-INDUCED CONDUCTIVITY IN MgO.
J.F.Marshall, M.A.Pomerantz and R.A.Shatas.
Phys. Rev., Vol. 106, No. 3, 432-4 (May 1, 1957).

The dependence upon temperature of the electrical conductivity induced in thin single crystals of MgO by bombardment with high-energy electrons which pass through the targets with negligible energy loss has been measured over the temperature range 200°K to 600°K. The experimental data are in accord with a theory which ascribes the observed decrease in conductivity as the temperature is raised to the predicted variation in the mobility of the charge carriers. The effects of scattering by both the optical modes and the acoustical modes of vibration of the lattice must be taken into account since neither the $\exp(\Theta/T)$ relationship resulting from the first type of interaction nor the $T^{-3/2}$ law arising from the second individually fits all of the data. The experiments also indicate that the concentration of trapping centres remains essentially constant over the temperature range investigated. The lifetime of the carriers is approximately 5×10^{-10} sec, and the trap density is estimated to be 10^{17} to 10^{18} cm^{-3}. A.

537.311.33 : 548.7

6175. LIFETIME OF CARRIERS IN LEAD SULFIDE CRYSTALS.
W.W.Scanlon.
Phys. Rev., Vol. 106, No. 4, 718-20 (May 15, 1957).

The relationship of carrier lifetime in lead sulphide crystals to the density of dislocations and crystal resistivity is studied experimentally. Dislocation density is obtained by etch-pit counting. Two groups of crystals are analysed: in one group the density of dislocations is approximately the same but the resistivity varies; in the other the resistivity is approximately the same but the density of dislocations varies. The carrier lifetime was found to be independent of the resistivity for a high dislocation density, ruling out the Auger process as an important recombination mechanism. Carrier lifetime was found to be inversely proportional to the density of dislocations, which suggests that the Shockley-Read recombination mechanism is an important one. A.

537.311.33 : 621.314.7

6176. THE DEPTH OF DIFFUSED LAYERS. W.L.Bond.
Bell Lab. Record, Vol. 35, No. 1, 1-5 (Jan., 1957).

Gives details, with illustrations, of a multiple-beam interferometric technique for determining the depth of the diffused layers in p–n junction devices produced by the diffusion process. The edge of the crystal is bevelled at about 5° to the plane of the junction, and the latter is identified by etching or copper-plating or by a hot-wire probe subsequently used to scribe a line on an "aquadag" coating. F.F.Roberts

537.311.33

6177. JUNCTIONS INDUCED IN GERMANIUM SURFACES BY TRANSVERSE ELECTRIC FIELDS. J.D.Nixon and P.C.Banbury.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 481-5 (May, 1957).

The surface conductance of germanium may be modulated by an external electric field. If the electrode used for applying the field does not cover the full extension of the specimen a boundary effect appears. In the presence of longitudinal currents the transition regions between the field-free and field-applied surfaces behave as junctions, giving rise to carrier concentration disturbances and also to rectification. The properties of a single field-induced junction have been investigated experimentally. A.

537.311.33 : 621.314.63

6178. EXCESS SURFACE CURRENTS ON GERMANIUM AND SILICON DIODES. W.T.Eriksen, H.Statz and G.A.deMars.
J. appl. Phys., Vol. 28, No. 1, 133-9 (Jan., 1957).

It is shown that inversion layers give an approximate logarithmic increase of excess current with applied voltage. Approximately ohmic excess currents are observed not only in the presence of water vapour but also in the presence of vapours of certain organic liquids. These excess currents can be shown to be due to a surface conductance which has a different bias voltage dependence from that exhibited by inversion layers. Evidence is presented which indicates that the holes induced in the liquid film (outer surface states) move in an applied field much like holes in a molten semiconductor, provided the liquid film is coherent. This added conductance is responsible for the ohmic behaviour in the presence of condensable vapours. A.

537.311.35

6179. ELECTRICAL RESISTIVITY OF CYCLOHEXANE AS A FUNCTION OF TEMPERATURE AND WATER CONCENTRATION. P.Staudhammer and W.F.Seyer.
J. appl. Phys., Vol. 28, No. 4, 405-10 (April, 1957).

An equation relating the potential applied to and the current flowing in a liquid dielectric has been derived. The theoretical equation predicts that beyond a certain threshold potential the current is independent of the applied potential and is proportional to the number of ions produced per unit volume per unit time. Measurements of the number of ions produced in cyclohexane as a function of temperature and water concentration were made. It was found that in the pure state about 200 ions $cm^{-3} sec^{-1}$ were produced, while in the water saturated cyclohexane at 50° C about 1.6×10^5 ions $cm^{-3} sec^{-1}$ were produced. It was concluded that the conductance in the pure state was due to ionization by cosmic radiation. When the cyclohexane was saturated with water, a large increase in the conductivity was observed as the cyclohexane passed through the freezing point. This behaviour corresponds to an increase in the dielectric constant as noted by Seyer and Barrow. A.

537.311.35

6180. THE D.C. CONDUCTIVITY OF LIQUID INSULANTS WHEN THE ELECTRODES ARE COVERED WITH A THIN FILM OF SOLID INSULATION. COMPARISON WITH THE USUAL CONDUCTIVITY OF THESE INSULATING SOLIDS AND LIQUIDS. R.Guizonnier.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 121A-128A (Nov., 1956). In French.

Discusses the effect of temperature and applied voltage on the charging and discharging currents in transformer oil and CCl_4, tested between electrodes 5 mm apart, each covered with a thin film of varnish. The effect of heterocharges on the varnish layers are particularly considered. J.H.Mason

537.311.4 : 621.3.066.6

6181. THE PHYSICS OF ELECTRICAL CONTACTS. F.Llewellyn Jones.
Oxford: Clarendon Press (1957) 219 pp.

Because of their wide application electrical contacts are broadly classified here as those used in: (i) power circuits; (ii) communication circuits; and (iii) circuits where the current and voltage are small. Problems in (i) are mainly those of electrical discharges; those in (ii) depend on the properties of metals at very high temperatures; in (iii) they involve the properties of surface tarnish films. The nine chapters are: Introduction, which outlines the problems encountered; Fundamental Concepts; Early Work on Contact Bridges, which analyses work done before 1945; Mechanism of Fine Transfer, which gives the mathematical theory of the bridge; Stability and Shapes of Molten-metal Bridges, which describes recent experimental work; Properties of Metals at high temperatures, which explains how the theory of contact physics is applied to the study of electrical, thermal and thermoelectrical properties of metals at temperatures up to their boiling points; Erosion and Transfer, which describes recent observations of erosion craters and discusses quantitative data obtained using radio-tracer techniques; Discharge Phenomena at Contacts, which discusses initiation, maintenance and extinction of discharges, pre-contact as well as at break; and Surface Film Phenomena, which describes the influence of tarnish films and deals with the carbon brush. Wherever possible rigorous mathematical analysis is given.

537.312.5

6182. THE PHOTOELECTRIC PROPERTIES OF GALLIUM ANTIMONIDE. F.Lukeš.
Czech. J. Phys., Vol. 6, No. 4, 359-63 (Aug., 1956). In Russian, with summary (400 words) in English.

The photoconductivity and spectral sensitivity of p-type GaSb were measured in the range 120 to 340° K. The long-wavelength edge occurs at about 1.6 to 1.8 μ. The temperature variation gives a gap width of $(0.723 \times 10^{-6} - 0.75 \times 10^{-6})T^2$ eV, in qualitative agreement with Antončik's theory of the shift of the absorption curve for non-polar crystals (Abstr. 7564/1956). It is also inferred that an increase in impurity concentration increases the gap width. J.B.Arthur

537.312.5

6183. AN INFRARED PHOTOCELL BASED ON THE PHOTO-ELECTROMAGNETIC EFFECT IN INDIUM ANTIMONIDE. C.Hilsum and I.M.Ross.
Nature (London), Vol. 179, 146 (Jan. 19, 1957).

Gives details of the construction and a curve of the spectral sensitivity of the cell. J.Dutton

537.312.5

6184. APPARATUS FOR THE STUDY OF PHOTOELECTRIC CELLS AT LOW TEMPERATURES. G.Blet.
Rev. Opt., Vol. 35, No. 8-9, 481-91 (Aug.-Sept., 1956). In French.

A photoelectric cell may be studied over the temperature range 60-300° K, in vacuo or in a gas. A modulated light beam falls on the cell and the corresponding a.c. component of the cell output is amplified and recorded on a cathode-ray-oscilloscope. A full description of the apparatus is given, together with sample results. R.W.Fish

537.312.5

6185. PHOTOELECTRIC EMISSION FROM SINGLE-CRYSTAL KI. H.R.Philipp and E.A.Taft.
Phys. Rev., Vol. 106, No. 4, 671-3 (May 15, 1957).

Photoelectric emission measurements were made on single crystals of KI. Yield curves, obtained after irradiation in the first fundamental absorption band, are similar to those observed on evaporated films and the features are attributed to direct ionization and exciton-induced emission from F-centres of density $\sim 10^{18}$ cm^{-3}, only 10 times lower than for films. At 80° K additional structure appears. A small yield for quantum energy below 2.5 eV is attributed to the presence of F'-centres. At 5.5 eV, the position of β-band absorption, a small peak is observed. An inversion in the exciton-induced emission yield at 5.8 eV is associated with the sharply peaked surface reflectivity. While the ratio of exciton-induced to direct ionization is slightly higher in crystals than in films, the effective cross-section for exciton-induced ionization is still $< 10^{-14}$ cm^2; thus, the photoemission provides direct evidence for energy transfer from excitons but not necessarily for migration. A.

537.312.5 : 535.343

6186. OPTO-ELECTRONIC PROPERTIES OF MERCURIC IODIDE. R.H.Bube.
Phys. Rev., Vol. 106, No. 4, 703-17 (May 15, 1957).

The optical and photoelectrical properties of mercuric iodide crystals and layers have been investigated, particularly as affected by the phase transformation from tetragonal (low-temperature form) to orthorhombic (high-temperature form) which occurs at 400° K. The largest temperature coefficient for band-gap variation of any known material is found for the orthorhombic form: -24×10^{-4} eV/degree. The following phenomena are discussed: (1) location and temperature dependence of absorption edge by measurements of transmission, reflectivity, and photoconductivity response spectra; (2) temperature dependence of dark current; (3) electrode effects in photoconductivity; (4) variation of dark current and photocurrent through the phase transformation; (5) thermally-stimulated currents; (6) variation of photocurrent with voltage, light intensity; and temperature. Temperature-quenching of photoconductivity in HgI_2 crystals can be described by means of the same analysis as has been applied to various $A^{II}B^{VI}$ photoconductors, giving a location of 0.5 eV above the valence band for the "sensitizing" centres in HgI_2. A.

537.312.5 : 548.736.3

6187. THE CHARACTERIZATION AND CRYSTAL STRUCTURE OF CAESIUM ANTIMONIDE, A PHOTO-ELECTRIC SURFACE MATERIAL. K.H.Jack and M.M.Wachtel.
Proc. Roy. Soc. A, Vol. 239, 46-60 (Feb. 12, 1957).

Although caesium antimonide is the most efficient photoemitter known, no adequate explanation has been offered for its unique properties. All previous attempts at its chemical and structural characterization have been unsuccessful. The present X-ray investigation shows that it is a "normal valency" intermetallic compound with a small range of homogeneity near to the composition Cs_3Sb. The atomic arrangement is pseudo-body-centred cubic with a defect structure based upon the B 32 sodium thallide type (NaTl). The

cubic unit cell (a = 9.14 to 9.19 A) contains sixteen atoms at special positions of space group $Fd3m - O_h^7$. Eight equivalent sites at $(0,0,0; 0,\frac{1}{2},\frac{1}{2}; \frac{1}{2},0,\frac{1}{2}; \frac{1}{2},\frac{1}{2},0) + 0,0,0; \frac{1}{4},\frac{1}{4},\frac{1}{4}$ are occupied solely by caesium atoms and eight other sites, at $(\ ) + \frac{1}{2},\frac{1}{2},\frac{1}{2}; \frac{3}{4},\frac{3}{4},\frac{3}{4}$, are occupied randomly by four caesium and four antimony atoms. The structure may be described as consisting of two interpenetrating diamond-type lattices, one of caesium atoms and the other of equal numbers of caesium and antimony atoms. The semiconducting properties of the material are explained by a filled Brillouin zone containing two electrons per atom. The crystal structure of caesium antinomide also suggests which of the previously proposed mechanisms for its photoemissivity is acceptable. The observed X-ray diffraction effects are accounted for only if the amplitudes of thermal vibrations are very much greater for caesium atoms than for antimony atoms. In caesium antimonide the root-mean-square displacements of the different atoms from their mean lattice positions (0.52 A for Cs and 0.25 A for Sb) are approximately the same as the corresponding displacements in metallic caesium and metallic antimony. This unexpectedly large difference between the Debye temperature factors of the different atoms causes the appearance of X-ray superlattice reflections which were at first thought to be due to specific shifts of some or all of the atoms from special positions. Although the assignment of separate temperature factors to different atoms is well known, the need for this is illustrated quite strikingly by the caesium antimonide diffraction pattern. A.

537.312.5

6188. ON THE EFFECT OF BOUNDARY LAYERS ON PHOTOCONDUCTION. F.Stöckmann.
Z. Phys., Vol. 146, No. 4, 407-22 (1956). In German.

Adsorption of impurities on photoconducting crystals modifies the dark current and also the photocurrent relation with the exciting light intensity, which usually occurs as a power law. Dependence of the relations and power index on the type of adsorption is quantitatively explored. G.F.J.Garlick

537.312.5

6189. THE PRODUCTION OF CONDUCTION ELECTRONS IN AgBr CRYSTALS BY IRRADIATION AT −170°C. L.Jung.
Z. Phys., Vol. 146, No. 4, 457-78 (1956). In German.

The photoconductivity of AgBr crystals and AgBr crystals containing Ag_2Se, Ag_2S and Ag_2Te impurity was investigated at −170°C using an alternating current bridge. On the assumption of direct excitation of electrons to the conduction band and subsequent trapping, three models are analysed and compared with the results obtained. Photoconductivity maxima occur at the same wavelength as the optical absorption due to impurity, irradiation with red light returns the crystal to its unexposed state and increased photosensitivity for blue and green light in the exposed crystal support the assumptions. J.E.Caffyn

537.312.5

6190. ON THE DEPENDENCE OF PHOTOCURRENTS ON THE ELECTRIC FIELD STRENGTH. F.Stöckmann.
Z. Phys., Vol. 147, No. 5, 544-66 (1957). In German.

It is pointed out that all photoconductors can be divided into four groups depending on their conduction mechanism, namely insulators, intrinsic semiconductors and two classes of extrinsic conductors. For low applied fields all classes show an ohmic relation between photocurrent and applied field, but at medium and high fields the behaviour is different for each group. The assignment of a photoconductor to a particular group depends to some extent on its mode of use. Furthermore the surface conditions of the material can affect the density distribution of charge carriers and hence the photocurrent. The kind of contact employed largely determines whether the photocurrent at high fields saturates or not. The physical arguments are extended by a mathematical analysis indicating which solutions apply to the four groups. C.A.Hogarth

537.312.5 : 537.311.33

6191. KINETICS OF THE AMBIPOLAR PHOTOELECTROMOTIVE FORCE IN A SEMICONDUCTOR WITH METALLIC ELECTRODES. E.I.Kaplunova and K.B.Tolpygo.
Zh. tekh. Fiz., Vol. 26, No. 10, 2165-9 (1956). In Russian.

An approximate theory of the photo-e.m.f. arising in a semiconductor with metal electrodes under modulated illumination is developed. The metal contacts are characterized by their effective transparencies to holes and electrons. Sinusoidal and square-pulse modulations of the light are considered. On the assumption that the light creates free holes and electrons, the theory predicts an almost square photoresponse with a slight initial rise and a small "tail" after the end of the light pulse. On the other hand, assuming that the light creates free holes and excitons, the theory predicts an initial decay of the photoresponse to a stationary level, and at the end of the pulse, a negative "overshoot". This latter shape has been observed experimentally by Potapenko (Dissertation, Kiev University, 1951) in Cu_2O, suggesting that the exciton mechanism is relevant in this material. J.B.Arthur

537.312.62

6192. ON THE NEW PHENOMENOLOGICAL THEORY OF SUPERCONDUCTIVITY. Yu.L.Klimontovich.
Dokl. Akad. Nauk SSSR, Vol. 104, No. 3, 384-6 (1955). In Russian.

In the theory of Ginzburg and Landau (Abstr. 1017/1952) the behaviour of superconductors is specified in terms of "effective" wave-functions and vector potentials. In the present note the foundations of that theory are examined. Equations determining effective wave-functions are obtained by an averaging procedure of the wave-equations for electrons in a magnetic field. In this way empirical parameters, connected with the effective wave-functions, are identified in terms of universal constants. A particular solution of equations for effective wave-functions is obtained and discussed in terms of experimental quantities and the dynamics of electrons in a magnetic field. R.Eisenschitz

537.312.62

6193. MICROSCOPIC THEORY OF SUPERCONDUCTIVITY. J.Bardeen, L.N.Cooper and J.R.Schrieffer.
Phys. Rev., Vol. 106, No. 1, 162-3 (April 1, 1957).

In the earlier theories of Fröhlich, Bardeen and Pines (e.g. Abstr. 2718/1952), it was supposed that superconductivity was due to a lowering of the self-energy of the individual electrons through electron–phonon interactions; a difficulty was that the calculated lowering in energy was far too large. It is now supposed that this self-energy is present in the normal state also, and that superconductivity is due to a further lowering in the total energy of the assembly through electron–electron interactions via the phonons. For small enough energy difference between the initial Bloch states this negative interaction energy outweighs the positive Coulomb interaction, and this leads to a criterion for superconductivity almost identical with Fröhlich's (Abstr. 2580/1953). An attempt is made to estimate the form of the ground-state and its resultant energy by picking out the matrix elements most effective in lowering the energy; these correspond to interactions between pairs of electrons of opposite spin and equal and opposite wave-vector. The energy lowering is not evaluated explicitly, but is not incompatible with the experimentally observed energy differences between normal and superconducting states. It is shown that the model explains the isotope effect, and that it leads to an energy gap kTG between the ground state and excited states; for tin T_G is estimated to be 13.8°K, compared with the observed 11.2°K. R.G.Chambers

537.312.6

6194. SUPERCONDUCTING PROPERTIES OF RHENIUM, RUTHENIUM, AND OSMIUM. J.K.Hulm and B.B.Goodman.
Phys. Rev., Vol. 106, No. 4, 659-71 (May 15, 1957).

Magnetic measurements have been made on the superconducting properties of rhenium, ruthenium, and osmium, and the influence of various methods of specimen preparation and treatment has been studied. In particular the transition temperature of rhenium could be raised by about 1°K above the ideal value, 1.699°K, by grinding or preparing the specimen as a powder. Although rhenium belongs to the transition elements, specimens of ideal superconducting behaviour could also readily be prepared. This reinforces the conclusion of previous workers that the nonideal superconducting behaviour frequently found in transtion-metal specimens is not a fundamental property of this group of elements, but a consequence of the metallurgical history of the specimens. A

537.312..

6195. MAGNETO-RESISTANCE EFFECTS IN THE GROUP I METALS AT HIGH FIELDS. R.G.Chambers.
Proc. Roy. Soc. A, Vol. 238, 344-57 (Jan. 8, 1957).

Measurements are reported on the resistivity and Hall coefficient of pure specimens of copper, silver and gold at 4°K in fields up to 25 kG. The theoretical form of the conductivity tensor in high fields is worked out, for arbitrary dependence of energy and relaxation time on wave-vector, and is found to be in qualitative disagreement with the experimental results. Possible causes of the discrepancy are discussed, and it is concluded that it probably arises not from quantization effects, but from the assumption in the theory that a relaxation time exists and is independent of field. A

537.313

6196. DIRECTIONS FOR APPLYING KIRCHHOFF'S RULES. G.Barnes.
Amer. J. Phys., Vol. 25, No. 1, 40-1 (Jan., 1957).

Definitions and a set of directions for applying the rules to network problems are given which have been found to be the simplest and most fool-proof in the teaching of first-year students.

W.Good

537.323

6197. ANISOTROPIC THERMO-ELECTRIC EFFECTS IN GRAPHITE. A.R.Ubbelohde and J.Orr.
Nature (London), Vol. 179, 193-4 (Jan. 26, 1957).

The thermoelectric power of graphite/copper along the c-axis is $\sim 30\ \mu V/^{\circ}C$ and $\sim 11\ \mu V/^{\circ}C$ along the a-axis. The form of the relation was confirmed up to 1200°C using "self-couples" between blocks cut along the a- and c-axes respectively and carrying out the measurements in a reducing atmosphere. Oxygen had a marked effect on the values of thermoelectric power obtained.

C.A.Hogarth

ELECTRIC DISCHARGES 537.52

537.521

6198. ENERGY RELATIONS DURING FORMATION OF STRIAE IN AN ELECTRICAL DISCHARGE. L.Pekárek and O.Štirand.
Czech. J. Phys., Vol. 6, No. 4, 364-75 (Aug., 1956). In Russian.

The paper describes an investigation into the energy relations during production of moving striae for a discharge in neon. A photomultiplier set up behind a slit at a point along the tube gives a nonsymmetrical record showing a nonsinusoidal transfer process. There is anomalous behaviour in the variation of potential with gas pressure on occurrence of striae. The variation of emitted light intensity with gas pressure is also anomalous. The authors conclude that with spontaneous occurrence of striae lowering of the energy losses in the plasma always occurs. C.R.S.Manders

537.521.6

6199. SQUARE-ROOT LAW AND BREAKDOWN CURRENT. M.Fucks and H.Niesters.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 447-54 (1956). In German.

Experimental arrangements for the measurement of initial currents I_0 and current at breakdown I_B are described. The results obtained for H_2 confirm the relationship $I_B = \psi\sqrt{I_0}$ (first suggested by W.Rogowski and W.Fucks, 1935) over a range of I_0 from 10^{-10} to 2.5×10^{-9} A. The similarity behaviour of the function ψ is discussed.

J.Dutton

537.521.6 : 621.387

6200. STUDY OF THE DIFFERENCE BETWEEN IGNITION AND EXTINCTION VOLTAGE OF A GLOW DISCHARGE UNDER VARIOUS CONDITIONS. M.Ya.Vasil'eva and N.A.Kaptsov.
Vestnik Moskov. Univ.,No. 2, 29-35 (1956). In Russian.

V(striking)–V(extinction) increases for increase of separation of the electrodes. Increase of gas pressure also causes increase of the voltage difference. Shape of the electrodes affects the results, the difference of the two potentials being greater when the cathode is plane and the anode spherical than for the opposite case or for two plane electrodes. Experiments were performed with electrodes of Ni and Al. C.R.S.Manders

537.521.7

6201. ON THE STATISTICS OF [SPARK] BREAKDOWN PROCESSES. W.Feldt and H.Raether.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 370-3 (1956). In German.

Gives data on breakdown times (statistical and formative lags) for uniform field discharges in air (pressure x gap length ~ 1000 mm. cm). Electron ("N_0") emission rates vary from ~ 10^6 to nearly 10^8 per sec. Von Laue plots of time lags are shown.

J.D.Craggs

537.521.7

6202. STATISTICAL PROBLEMS OF FORMATIVE PROCESSES IN THE TOWNSEND DEVELOPMENT OF GASEOUS DISCHARGES. W.Legler.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 374-8 (1956). In German.

A brief theoretical study of avalanche build-up processes (Townsend discharges). Experimental data of Feldt and Raether (preceding abstract) are considered. J.D.Craggs

537.521.7

6203. THE INFLUENCE OF ATMOSPHERIC MOISTURE ON THE ELECTRICAL BREAKDOWN IN AIR. W.Köhrmann.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 379-84 (1956). In German.

Gives the results of measurements of the breakdown voltage V_S and formative time lag T_f for plane parallel gaps (0.5 to 2.0 cm) in air (at pressures of 500 and 760 mm Hg) containing known proportions of water vapour. The dependence of V_S and T_f on the partial pressure of the water vapour is shown. The results are discussed in terms of the Townsend and "Kanal" mechanisms of ionization growth. J.Dutton

537.521.7

6204. THE INFLUENCE OF ATMOSPHERIC MOISTURE ON THE BREAKDOWN VOLTAGE OF A PLATE SPARK GAP. G.A.Schröder.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 385-6 (1956). In German.

The breakdown voltage of air is shown to increase with increasing water vapour content in the range of pressure x distance from 3000 to 4000 mm. Hg. cm. J.Dutton

537.521.7

6205. BREAKDOWN FIELDS OF ACTIVATED ELECTRICAL CONTACTS. F.E.Haworth.
J. appl. Phys., Vol. 28, No. 3, 381 (March, 1957).

The apparent breakdown field between Pd contacts operated in d-limonene vapour decreases with the number of operations due to the deposition of carbon particles. The discharges probably destroy the particles from which they are initiated so that the apparent gap is greater than the effective gap. It is concluded that activation does not enhance electron emission; see Abstr. 5799 (1952). J.H.Mason

537.521.7

6206. MEASUREMENTS OF SPARKOVER VOLTAGES IN COMPRESSED H_2 AND N_2. A.Boulloud.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 129A-134A (Nov., 1956). In French.

Measurements of d.c. sparkover voltages up to 140 kV across Araldite and Plexiglass samples between parallel plates and between a 6 mm dia. hemispherical point and plane having 7 and 10 mm gaps in H_2 and N_2 compressed up to 25 atm. It is found possible to withstand higher voltages in H_2 than in N_2 over certain pressure ranges with a solid insulator as a shield between metal electrodes, whose positive electrode has a strong curvature. Similar to positive point–plane gaseous insulation, a maximum breakdown voltage can be observed with increase in pressure. Both these effects are briefly interpreted, and application to electrostatic generators is mentioned.

A.E.D.Heylen

537.523.5

6207. THE AXIAL TEMPERATURE DISTRIBUTION IN THE INTERIOR OF THE ANODE OF CARBON ARCS AND THE COEFFICIENT OF THERMAL CONDUCTIVITY OF GRAPHITE AT HIGH TEMPERATURES. J.Euler.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 345-69 (1956). In German.

Describes optical systems for the study of electrode crater regions in arc discharges, carrying currents of 10-20 A. There is a full discussion of thermal properties (heat loss mechanisms etc.) of crater regions for temperatures varying up to about 4000°K. The treatment, experimental and theoretical, is detailed and exhaustive.

J.D.Craggs

537.523/.527

6208. SIMPLE MOVABLE-PROBE ARRANGEMENT. G.Medicus.
Rev. sci. Instrum., Vol. 27, No. 12, 1083 (Dec., 1956).

A small, stable arrangement for probing gas discharges is shown diagrammatically. The motion of the probe is free of hysteresis, and its location can be read on a scale and pointer fixed outside. No flexible lead is required. J.H.Mason

537.523 : 537.525 : 537.564

6209. POSSIBLE PROCESSES FOR THE SECONDARY ELECTRON EMISSION IN AIR EXCITED BY EXTERNAL SLEEVES. D.P.Jatar and H.D.Sharma.
Sci. and Culture, Vol. 22, No. 6, 332-3 (Dec., 1956).

Continuation of previous work (Jatar, J. sci. industr. Res., Vol. 9B, 283, 1950). Breakdown voltages under 50 c/s mains excitation for dry air in the range of pressure x separation from 0 to 125 (mm Hg) (cm) correspond to field-to-pressure ratios (X/p) in the range 60 to 250 (V/cm) (mm Hg). Secondary ionization coefficient was calculated from the Townsend criterion and was found to have a pronounced peak at X/p ~ 80 (V/cm)(mm Hg). C.G.Morgan

537.523.3

6210. CONSTANT COMPONENT OF A CORONA DISCHARGE IN A HIGH-FREQUENCY FIELD. P.A.Petrov and A.A.Kuzovnikov.
Vestnik Moskov.Univ., No. 6, 39-46 (1956). In Russian.

The paper gives the results of an investigation of the variation of the constant component of the h.f. current in a corona discharge with h.f. voltage and of a constant electric field (photographs). All experiments were carried out in air at atmospheric pressure at frequencies 1.5 and 5 Mc/s. C.R.S.Manders

537.523.5

6211. AN EXPLANATION OF THE TANBERG EFFECT.
A.E.Robson and A.von Engel.
Nature (London), Vol. 179, 625 (March 23, 1957).

A new explanation of the Tanberg effect is proposed in connection with the authors' recent theory of the cathode spot in arc discharges (Abstr. 6171/1955). The explanation follows from the consideration of back-scattering in the cathode region. The velocities of evaporating atoms were calculated considering the returning atoms, and are said to be about 10^4 cm/sec., i.e. reasonable thermal velocities. J.M.Zarzycki

537.523.5 : 537.527.5

6212. THE DETERMINATION OF ARC TEMPERATURES FROM SHOCK VELOCITIES. H.Edels and D.Whittaker.
Proc. Roy. Soc. A, Vol. 240, 54-66 (April 24, 1957).

The measurement of the high gas temperatures associated with arc discharges requires special techniques. One such method, developed by Suits (1935), depends on the measurement of the velocity of a sound wave passing through an arc column, although in fact Suits measured the velocity of a very weak shock wave. The new method described in the present paper is one in which temperatures are determined from the measurement of the velocity of a relatively strong shock wave propagated through an arc. The new methods has the merit of consistently producing accurately measurable records and of increasing the accuracy of the temperature determination. The shock velocities are measured by means of a rotating mirror camera. Within the arc, the shock propagation is observable by virtue of the increased arc brightness produced by the shock. In the non-luminous regions surrounding the arc, the shock propagation is displayed by means of a Schlieren system. The interpretation of the measurements depends upon a one-dimensional analysis given in this paper which is similar to that of Chisnell (1955) and which describes the interaction of a plane shock with a continuously varying temperature distribution. In our analysis account is taken also of the continuous variation in specific heats and molecular weight which are of importance under high gas temperature conditions. In practice plane-wave theory cannot adequately describe the shock propagation, since attenuation occurs both in the free gas and in the arc column. The effects of this attenuation on the temperature determinations may be accounted for by the use of an experimentally determined attenuation relationship given in the paper. The finally developed method yields temperature values of an accuracy of ±2%. Experiments are described for carbon and tungsten arcs in air and nitrogen for currents up to 55 amperes and pressures up to 3 atmospheres. The values obtained range from 6200 to 7700° K and are in good agreement with values determined by other techniques. A.

537.523.5

6213. THE ENERGY BALANCE AT THE ELECTRODES AND CHARACTERISTICS OF FREE-BURNING LOW PRESSURE ARCS.
W.Rieder.
Z. Phys., Vol. 146, No. 5, 629-43 (1956). In German.

Measurements were made in air, with copper, silver and tungsten electrodes of (total voltage)/(gap length) relations and current--voltage characteristics. Calorimetric measurements of energy dissipation at the electrodes were also made for currents ranging up to about 30 A, and arc lengths up to about 12 mm. The results are interpreted in terms of an energy balance. J.D.Craggs

537.525

6214. ON THE THEORY OF THE STATIONARY MICROWAVE DISCHARGES. W.Flügge.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 251-61 (1956). In German.

A characteristic equation for microwave discharges is developed without making the assumption of quasi-neutrality. Using the known values for elastic, excitation and ionization cross-sections, the breakdown field and burning field are calculated for A and found to be in good agreement with experiment. J.Dutton

537.52

6215. THE BREAKDOWN OF POSITIVE COLUMNS OUT OF LOW PRESSURE PLASMA. G.Mierdel.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 262-77 (1956). In German.

An experimental arrangement is described for the measurement of the breakdown voltage V_S between an anode situated in a narrow glass side tube and the plasma of a d.c. discharge. The dependence of V_S on the position of the anode, the current in the discharge and the gas pressure was investigated for A and for Hg vapour. The plasma is found to penetrate a certain distance into the side tube, and the two types of discharge obtained, depending on whether the anode is inside or outside the plasma, are discussed. J.Dutton

537.525

6216. A NEW PROCEDURE FOR THE DETERMINATION OF THE PLASMA POTENTIAL IN LOW PRESSURE DISCHARGES. E.Nölle.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 328-34 (1956). In German.

The Langmuir characteristic can be determined if the a.c. current due to a small superimposed a.c. voltage, is measured as a function of the d.c. probe potential. The d.c. potential at which peak a.c. current is registered, is the plasma potential, even if electron distribution is non-Maxwellian. Maximum a.c. voltage 2 V; optimum probe dimensions 1 mm long, 0.2 mm dia. Advantage is that readings can be taken instantly after probe cleaning-up process; then results are independent of probe material (Pt, W, Mo, Ta, Cu). Restriction is that point of inflection in Langmuir curve must occur at plasma potential. A.E.D.Heyler

537.525 : 523.0

6217. SIMULATION OF ASTROPHYSICAL PROCESSES IN THE LABORATORY. W.H.Bostick and O.A.Twite.
Nature (London), Vol. 179, 214-15 (Jan. 26, 1957).

A plasma source is used to project plasma-magnetic entities across a strong magnetic field in a vacuum, with velocities up to 10^7 cm/sec. Photographs of some of the discharge patterns are reproduced. It is suggested that the laboratory phenomena are directly related to certain geometrically similar astrophysical processes. See also Abstr. 2935 (1957). D.R.Barbe

537.52

6218. EXPERIMENTAL STUDY OF PLASMOIDS. W.H.Bostick.
Phys. Rev., Vol. 106, No. 3, 404-12 (May 1, 1957).

A plasma source can be used to project ionized matter across a magnetic field. The configuration of plasma observed when an electromagnetic braking action is produced by the presence of low-pressure gas ($\sim 1\,\mu$) in the vacuum chamber provides an insight into the manner in which magnetic-field lines can be dragged and twisted. By firing several sources simultaneously, it is possible to simulate in geometrical form the production of spiral galaxies and barred spirals. A.

537.525 : 537.56

6219. ON THE ACCELERATION OF A PLASMA BY A MAGNETIC FIELD. A.I.Morozov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 305-10 (1957). In Russian.

Acceleration of a current-conducting plasma jet by a magnetic field is considered. The nature of the processes is preliminarily elucidated by examining the case of motion of conductors possessing some resistance and inductance. Furthermore, the motion of ions and electrons is studied under conditions when collisions, magnetic interaction of the particles and excitation of waves are neglibible. The existence of a critical charge density in accelerators has been established for this case. Peculiarities of acceleration of very dense jets are also considered. A.

537.525

6220. PRODUCTION OF THE JOSHI EFFECT IN BROMINE EXCITED BY AN ELECTRICAL DISCHARGE.
B.B.Prasad and D.P.Jatar.
J. sci. Res. Banaras Hindu Univ., Vol. 6, No. 1, 93-130 (1955-56).

A very detailed account of the effect of external irradiation on high-voltage a.c. electrodeless ("ozonizer") discharges in bromine vapour. Many data are presented in graphical and tabular form. J.D.Cragg

537.525.

6221. THE ANODE FALL IN LOW PRESSURE DISCHARGES.
W.Bez, K.H.Höcker amd B.Mayser.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 335-44 (1956). In German.

Extends previous theory (Abstr. 5900/1956) to the case of low

pressure discharges. Values of the anode falls calculated for discharges in Ne, Ne+Hg and A are compared with experimental results of other authors, and the dependence of the anode fall on pressure and current density is discussed. J.Dutton

537.525.8 : 535.33

6222. OBJECTIVE SPECTROPHOTOMETRIC OBSERVATIONS ON GLOW DISCHARGES. F.Schneider.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 297-311 (1956). In German.

Describes a photoelectric system for the measurement of the intensity of lines and bands in the emission spectra of glow discharges. Results are given for He, Ne, Hg, H_2, N_2 and O_2 (pressures ~ 1 mm Hg). Intensities of lines as a function of distance from the cathode are given. J.D.Craggs

537.525.8

6223. THE DISTRIBUTION OF THE CURRENT DENSITY OVER THE CATHODE OF A GLOW DISCHARGE. W.Weizel and G.Müller.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 417-40 (1956). In German.

The detailed characteristics of discharges between an anode and a particular extended hollow-cathode arrangement were investigated experimentally, and the results explained in terms of a transverse current from one part of the cathode to another. J.Dutton

537.525.8

6224. EFFECT OF MICROWAVE SIGNALS INCIDENT UPON DIFFERENT REGIONS OF A D.C. HYDROGEN GLOW DISCHARGE. B.J.Udelson.
J. appl. Phys., Vol. 28, No. 3, 380-1 (March, 1957).

Describes experiments in which the discharge tube (3 mm pressure) is moved along the axis of an S-band cavity so that the microwave-field passed through different parts of the discharge. The variation of, effectively, discharge current with microwave-field position was studied. Only in the Faraday dark-space was the effect marked; there was a current decrease when the microwave field was switched on. It is suggested that the effect is due to an increase in electron diffusion rate. J.D.Craggs

537.525.8

6225. CATHODE FALL, CURRENT DENSITY AND WIDTH OF CROOKES DARK SPACE OF THE NORMAL GLOW DISCHARGE IN RARE GAS—HYDROGEN MIXTURE. G.Ulrich.
Wiss. Z. Hochsch. Elektrotech. Ilmenau, Vol. 2, No. 2, 145-53 (1956). In German.

With experimental elimination of cathode edge effect and use of highest purity gases, Güntherschulze's measurements were repeated for admixtures of hydrogen to He, Ne, A in the gas ratio 10^{-5}/1 to 1/1 over pressure range 1 to 3 mm Hg. The observed behaviour of cathode fall and Crookes dark space (C.D.S.) as function of mixture ratio is in rough agreement with von Engel-Steenbeck theory. About 25% lowering in cathode fall and C.D.S., observed for very small admixtures of H_2 (as little as 10^{-5}/1), is ascribed to the Penning effect. The behaviour of current density suggests that positive ions present are protons. A.E.D.Heylen

537.527.5 : 535.89

6226. THE DETERMINATION OF THE RADIAL VARIATIONS OF DENSITY AND TEMPERATURE IN A XENON SUPER-PRESSURE LAMP. H.Burck.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 312-20 (1956). In German.

X-ray absorption measurements of discharge column densities were made on mercury and xenon discharges for pressures varying up to 100 atm or more. Temperatures were then deduced. Detailed data are shown for an XBO 500 (xenon) lamp. J.D.Craggs

537.527.5

6227. INVESTIGATION OF THE CATHODE FALL IN THE TRANSITION REGIONS FROM THERMAL ARCS TO FIELD ARCS AND FROM ARCS TO GLOW DISCHARGES. A.Bauer.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 387-400 (1956). In German.

Measurements were made of the cathode falls in Xe arcs with spherical W cathodes at gas pressures in the range 1 to 60 atm by a method described previously (Abstr. 1876/1955). The arc mechanism is discussed with reference to the results obtained. J.Dutton

537.527.5

6228. INVESTIGATIONS ON THE POSITIVE COLUMN OF XENON HIGH-PRESSURE ARCS AT HIGHER LOADINGS. P.Schulz and B.Steck.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 401-16 (1956). In German.

Gives detailed results of experiments carried out over a pressure range 8-35 atm and for currents varying between 10 and 35 A. Measurements of voltage gradient, energy dissipation per cm length, brightness etc. were made and are presented in graphical and tabular form. The product (electron density x electron mobility) is deduced and discussed. J.D.Craggs

537.527.5

6229. HIGH-PRESSURE DISCHARGES IN XENON WITH HELIUM ADDITIONS. P.Schulz and H.Strub.
Z. Phys., Vol. 146, No. 4, 393-406 (1956). In German.

The luminous and electrical characteristics of arcs in xenon (30-40 atmospheres pressure), to which 0-3 atmospheres of helium were added, are described. The effect of the helium is demonstrated graphically. There is a brief theoretical discussion. J.D.Craggs

537.527.5

6230. ON THE DISCHARGE MECHANISM OF HIGH-TEMPERATURE ARCS. G.Busz-Peuckert and W.Finkelnburg.
Z. Phys., Vol. 146, No. 5, 655-63 (1956). In German.

A general discussion of the discharge mechanism of high-current (up to ~ 200 A) arcs. Plasma temperatures may be ~ 20 000°K. Energy balance, current- voltage characteristics and ionization balance relation are discussed with special reference to argon and nitrogen arcs. J.D.Craggs

537.528 : 532.7

6231. ELECTRIC STRENGTH AND LIQUID STRUCTURE. T.J.Lewis.
J. appl. Phys., Vol. 28, No. 4, 503-5 (April, 1957).

Recent work on the electric strength of pure hydrocarbon liquids has shown that the strength is probably determined by the amount of energy lost by conduction electrons exciting molecular vibrations by collisions while moving under the applied field through the liquid. The strength can then be determined in terms of a mean free path for the collisions involved. The present paper attempts to show that the liquid structure, i.e., the molecular arrangements in the liquid phase, is also influencing the strength, and this is illustrated by measurements of the temperature effect on the strength of some n-paraffins, the molecules of which are known to pack with their long axes parallel producing a degree of anisotropy. Distinct breaks in the electric strength v. temperature characteristics are found, even when density changes are accounted for, and these occur at temperatures which are in very good agreement with similar breaks in the characteristics of other properties such as density, viscosity, and heat capacity. These breaks have already been associated with changes in liquid structure from quasi-crystallinity to molecular libration (245°K) and from molecular libration to free rotation (288-353°K). If molecular orientation takes place in the applied field then the electron energy loss will be different in the three liquid "phases" and would account for the observed transitions in the breakdown characteristics. A.

X-RAYS 537.531

537.531 : 535.331

6232. $L_{2,3}$ AND K EMISSION SPECTRA OF MAGNESIUM, ALUMINIUM AND LITHIUM IN HIGHER ORDERS. A.K.Sen.
Indian J. Phys., Vol. 30, No. 8, 415-22 (Aug., 1956).

$L_{2,3}$ and K emission spectra have been studied in higher orders by a newly built soft X-ray ruled grating vacuum spectrograph of one metre radius. The band width, band structures and the edge breadths have been determined accurately from the calibration curve. The agreement between the band widths of K valence band and L_3 band has been discussed in the case of magnesium and aluminium. A.

537.531.08 : 539.166.08

6233. USE OF FERROUS SULPHATE SOLUTIONS FOR X-RAY DOSIMETRY. M.H.Back and N.Miller.
Nature (London), Vol. 179, 321-2 (Feb. 9, 1957).

Measurements of the ratio of the yield of molecular hydrogen to that of ferric ion in solutions initially saturated with oxygen, for (a) Co^{60} γ-rays; (b) unfiltered radiation from a 250 kV constant potential therapy unit; (c) unfiltered radiation from a 50 kV therapy unit. Results: for (a) the ratio is 0.0258 ± 0.0008; for (b) 0.0305 ± 0.0009; for (c) 0.0327 ± 0.0014. From these values, and knowledge of G for H_2O as a function of radiation quality, it is calculated that G for Fe^{3+} (250 kV) is 14.9 ± 0.8 ferric ions per 100 eV absorbed, and G for Fe^{3+} (50 kV peak) is 14.0 ± 0.8. L.Pincherle

CATHODE RAYS.

POSITIVE RAYS 537.533/.534

537.533

6234. DEVELOPMENT OF AIR-CORED BETATRONS WITH OPERATING FREQUENCIES OF 2.5 kc/s and 8 kc/s. G.Hentze.
Ann. Phys. (Leipzig), Vol. 19, No. 1-2, 55-81 (1956). In German.

The advantages of air-cored betatrons for the attainment of energies in the 1-2 MeV range are discussed. The use of a relatively high frequency leads to the choice of a small equilibrium radius (25 mm for the 8 kc/s machine), and this is shown to favour a large total charge accelerated per cycle. The practical realization of the designs, the measurement of the magnetic field distribution, the injection of the electrons and the extraction of the accelerated beam are discussed in some detail. Energies of 1 MeV have been attained, but no quantitative results on the intensity are given.

E.A.Ash

537.533 : 548.74

6235. LINEAR ACCELERATOR WITH PRE-BUNCHING OF ELECTRONS. APPLICATIONS TO ELECTRON DIFFRACTION BETWEEN 0.5 AND 1 MeV. M.Papoular.
Ann. Phys. (Paris), Ser. 13, Vol. 1, 914-58 (Nov.-Dec., 1956). In French.

In two parts. The first describes the design of the accelerator and pre-buncher. A method of measuring the velocity of electrons in the range 0.4 c to c is described in which the electrons pass near a broad-band slow-wave line. The measured frequency of the waves excited in the line is related to the velocity by formulae used in carcinotron theory. The second part describes electron diffraction studies using the accelerator. Debye–Scherrer rings were obtained for gold and zinc oxide films. Mica gave N- and L-type spot diagrams and Kikuchi lines (type P). A detailed study of the latter was made. Results agree with the dynamic diffraction theory.

J.W.Sturgess

537.533.1 : 537.562

6236. FREE PATH FORMULAE FOR THE COEFFICIENT OF DIFFUSION AND VELOCITY OF DRIFT ELECTRONS IN GASES. L.G.H.Huxley.
Austral. J. Phys., Vol. 10, No. 1, 118-29 (March, 1957).

Free path methods are used to derive formulae for the coefficient of diffusion and the drift velocity of electrons in weakly ionized gases in the general case in which the collisional cross-section is a function of the speed of an electron and the law of scattering of electrons in single collisions with molecules is not restricted to a few specific cases. It is found that the results are, in effect, the same as those derived by means of the methods of Maxwell and Boltzmann. The significance of the investigation for the interpretation of laboratory measurements of electronic diffusion and drift is also discussed.

A.

537.533.1.08

6237. THE MEASUREMENT OF THE DRIFT VELOCITY OF ELECTRONS THROUGH GASES BY THE ELECTRON SHUTTER METHOD. R.A.Duncan.
Austral. J. Phys., Vol. 10, No. 1, 54-9 (March, 1957).

The behaviour of an electron shutter apparatus such as that used by Neilsen and Bradbury (1936, 1937) for the measurement of electron velocities is analysed, taking into account the effect of electron diffusion. A relation between shutter frequency and drift velocity, and a relation giving the accuracy obtainable by the method in terms of the chamber length and gas pressure are derived. It is thus shown that neglect of the influence of diffusion can lead to large errors, but that these can be reduced to any desired degree by increasing the chamber length or the gas pressure. Numerical examples are given.

A.

537.533.2

6238. DISCUSSION SESSION ON "EXO-ELECTRONS". FOREWORD. K.Lintner and E.Schmid.
Acta phys. Austriaca, Vol. 10, No. 4, 313-14 (1957). In German.

Exo-electron emission known sometimes as the Kramer effect, covers the production of electron emission from the surface of metals and non-metals occurring during or after various treatments or excitations, e.g. due to strain deformation, chemical action, heating crystal structure changes, photon and corpuscular excitation. Photoelectricity would appear to be a special case of exo-electron emission. For details of the other papers given at this session, see the abstracts that follow.

G.F.J.Garlick

537.533.2

6239. THE PROBLEM OF EXO-ELECTRONS. K.Lintner.
Acta phys. Austriaca, Vol. 10, No. 4, 315-26 (1957). In German.

Presents a review of exo-electron emission researches, including experimental techniques and examples of the various ways of obtaining the emission (as described in preceding abstract). 37 references are given.

G.F.J.Garlick.

537.533.2

6240. EXO-ELECTRONS AFTER IRRADIATIONS. J.Kramer.
Acta phys. Austriaca, Vol. 10, No. 4, 327-38 (1957). In German.

Processes which give rise to luminescence can also give rise to electron emission and the correspondence between the two phenomena provides important ideas on the processes involved in emission. Results are given for alkali halides and sulphates and also for aluminium oxide.

G.F.J.Garlick

537.533.2 : 535.37

6241. EXO-ELECTRON EMISSION AND LUMINESCENCE. W.Hanle.
Acta phys. Austriaca, Vol. 10, No. 4, 339-52 (1957). In German.

The analogies between exo-electron emission and luminescence are reviewed. Experimental techniques are described followed by a discussion of theoretical energy-band models. Experimental results from other authors are quoted with special reference to NaCl, CaF_2, and Al_2O_3 phosphors.

G.F.J.Garlick

537.533.2

6242. ON THE PROBLEM OF THE BASIC MECHANISM OF COLD ELECTRON EMISSION FROM SOLIDS. A.Bohun.
Acta phys. Austriaca, Vol. 10, No. 4, 353-64 (1957). In German.

A discussion is provided of the results of exo-electron emission from non-metallic solids after various kinds of excitation. The effect of crystal surfaces and internal defects and impurities on the electron emission is discussed.

G.F.J.Garlick

537.533.2

6243. ELECTRON EMISSION FROM METAL SURFACES AS A RESULT OF ELECTRIC FIELDS IN TRACES OF INSULATING IMPURITY. F.Kirchner.
Acta phys. Austriaca, Vol. 10, No. 4, 365 (1957). In German.

A discussion of the effect of impurity ions or atoms on electron emission from tungsten points in the Müller field emission microscope.

G.F.J.Garlick

537.533.2

6244. THE ELECTRON EMISSION OF COLD LIQUID METAL DROPS.
H.Hohn, H.Bildstein, T.Amminger-Schlager and H.W.Einhaus.
Acta phys. Austriaca, Vol. 10, No. 4, 366-74 (1957). In German.

The exo-electron emission from liquid mercury or amalgams is observed for droplets forming in an inert gas atmosphere. The effect increases with droplet size and formation velocity. Light must be excluded to prevent photoelectric effects. The detailed processes involved are not resolved.

G.F.J.Garlick

537.533.2

6245. THE SIMILARITY OF THE EMISSION CENTRES IN ALUMINIUM SURFACES FOR DIFFERENT METHODS OF PREPARATION. L.Grunberg and K.H.R.Wright.
Acta phys. Austriaca, Vol. 10, No. 4, 375-91 (1957). In German.

The difficulties of applying exo-electron emission in surface studies are discussed. Studies of emission from aluminium surfaces prepared by melting and evaporation, drawing and etching are made. The sensitivity spectrum for optical irradiation is independent of the method of preparation. The electron emission changes in a similar way with applied potential and light intensity for all specimens. Emission for $\lambda < 3700$ A is associated with the metal as well as with its oxide layer while that for $\lambda = 4700$ A is associated with the presence of colour centres in the oxide.

G.F.J.Garlick

537.533.2

6246. APPLICATION OF EXO-ELECTRONS. J.Kramer.
Acta phys. Austriaca, Vol. 10, No. 4, 392-8 (1957). In German.

The use of exo-electron emission in studying surfaces is discussed. The surface state conditions can be measured by the emission magnitude, and their changes during physical or chemical treatment measured, e.g. during adsorption or catalysis or during and after particle bombardment.

G.F.J.Garlick

537.533.2

6247. ON THE ELECTRON EMISSION FOR CRYSTALLOGRAPHIC CHANGES. G.Bathow.
Acta phys. Austriaca, Vol. 10, No. 4, 399-401 (1957). In German.

537.533.2

6248. ON THE CHARACTERISTICS OF THIN LAYERS OF COPPER AND IRON. R.Seidl.
Acta phys. Austriaca, Vol. 10, No. 4, 402-8 (1957). In German.

Variation of exo-electron emission with temperature for thin layers of copper and iron is measured for various conditions: (a) After evaporation of the metal layer, (b) after oxidation, (c) after irradiation by very slow electrons, (d) after X-ray irradiation. The conductivity of the layers was also measured as a check on layer properties. G.F.J.Garlick

537.533.2

6249. PHOTOELECTRIC INVESTIGATIONS ON UNDEFORMED AND PLASTICALLY DEFORMED SINGLE CRYSTALS OF ALUMINIUM. H.Müller and F.Weinberger.
Acta phys. Austriaca, Vol. 10, No. 4, 409-20 (1957). In German.

Plastically deformed metals show a higher photoelectric sensitivity. In the case of aluminium the effect is independent of crystal orientation. Similar effects are obtained by etching or electrolytic polishing. The studies show that the photoelectric charges are due less to a direct effect of deformation than to a sensitization of response by the adsorption of gases on increased free surfaces of slip planes. G.F.J.Garlick

537.533.2

6250. INFLUENCE OF THE GRADIENT OF THE EXTERNAL ELECTRIC FIELD ON THE CHEMO-EMISSION.
St. Koc and F.Roubínek.
Acta phys. Austriaca, Vol. 10, No. 4, 421-6 (1957). In German.

The influence of external field gradient and chemical change in a solid (on being oxidized) on electron emission from the latter is investigated. The effect was measured by use of a Geiger–Müller tube in which the solid formed one cylindrical electrode. The change of emission with temperature determines the activation energy for the effect. G.F.J.Garlick

537.533.2

6251. NEW RESULTS ON EXO-ELECTRON EMISSION FROM NON-METALS. G.Gourgé and W.Hanle.
Acta phys. Austriaca, Vol. 10, No. 4, 427-47 (1957). In German.

Comparison of decays of electron emission and luminescence emission are made for $CaSO_4$-Mn and NaCl-Ag phosphors. Experiments are also reported which compare the thermoluminescence and exo-electron emission during warming. Both electron and luminescence emission depend on the nature of the excitation, particularly on the depth of excitation in the phosphors. G.F.J.Garlick

537.533.2

6252. DELAYED ELECTRON EMISSION FROM GERMANIUM. K.Seeger.
Acta phys. Austriaca, Vol. 10, No. 4, 448-52 (1957). In German.

A 1 cm^2 Ge surface is irradiated with 1 keV electrons at 90° K (10^{-6} A current) and shows a slow decay of electron emission (100 electrons/sec at 1 min after excitation). Warming at 1 deg. C/sec produces several maxima in the emission up to 500° C. No delayed emission is shown after excitation by long wavelength ultraviolet light. The centres responsible are probably more than 4 eV above the valence band and only a fraction of an eV below the free space potential (work function assumed to be 4.6 eV for Ge). G.F.J.Garlick

537.533.2 : 541.128

6253. ON THE PROBLEM OF ELECTRON EMISSION FROM CATALYSTS. H.Nassenstein and R.Menold.
Acta phys. Austriaca, Vol. 10, No. 4, 453-9 (1957). In German.

The exo-electron v. temperature curves are measured for an electrolytic silver catalyst after X-ray excitation at room temperature and for heating in different atmospheres. The significance of the experimental method in the study of catalytic action is discussed. G.F.J.Garlick

537.533.2

6254. ON THE INDUCED EMISSION OF PHOTOELECTRONS IN A GASEOUS ATMOSPHERE. B.Sujak.
Acta phys. Austriaca, Vol. 10, No. 4, 460-73 (1957). In German.

NaCl and KCl layers deposited in a photon counter tube (G.M. counter) give rise to photon sensitivity in their F-centre bands when the tubes are sensitized by a sustained glow discharge. A longer wavelength sensitivity also occurs when F-centres are present. The effects are explained by assuming an inner photoelectric effect in the layers and a tunnel process through the surface made possible by the adsorption of gaseous ions. Glass layers also show a similar effect. A study of an Al_2O_3 layer on aluminium as a photocathode is also carried out. G.F.J.Garlick

537.533.2

6255. INVESTIGATION OF COPPER OXIDE BY MEANS OF EXO-ELECTRONS. H.Müller.
Acta phys. Austriaca, Vol. 10, No. 4, 474-80 (1957). In German.

Copper specimens, with different amounts of oxidation, and self-supporting copper oxide layers were studied with respect to exo-electron emission after excitation by X-rays. "Electron glow curves" of the excited layers are measured and a discussion in terms of lattice defects given. G.F.J.Garlick

537.533.2

6256. CONCERNING THE MECHANISM OF THE EMISSION PROCESS IN CHEMOEMISSION. R.Seidl.
Czech. J. Phys., Vol. 6, No. 5, 487-95 (Oct., 1956). In German.

Contribution to the study of chemoemission, i.e. emission of electrons due to certain processes such as the interaction of a reactive gas with the surface of a solid. Experiments using the incidence of very slow electrons throw some light on the relationship between two proposed explanations, one in terms of exothermic processes at the solid surface, the other in terms of thermionic emission from colour centres (F,F' or other). B.Meltzer

537.533.3

6257. EXAMPLES OF RIGOROUSLY CALCULABLE ION AND ELECTRON PATHS IN PLANE ELECTROSTATIC FIELDS. H.Grümm and H.Spurny.
Acta phys. Austriaca, Vol. 11, No. 1, 11-22 (1957). In German.

Staeckel's method for the separation of the Hamilton–Jacobi differential equation leads to rigorous solutions for electron trajectories in particular plane fields. The cases of homogeneous and hyperbolic fields are fully treated, and by a change of coordinates the method is applied to a field in which the equipotentials are cardioids. A.E.I. Research Laboratory

537.533.3

6258. INVESTIGATION OF A SPECIAL DEFLECTION SYSTEM FOR ELECTRON BEAMS. R.Gain.
Optik, Vol. 14, No. 2, 49-71 (Feb., 1957). In German.

Describes a new system for the deflection of electrons. This consists of a flat plate and a single wire, held at a potential differing from that of the accelerating electrodes. Approximate formulae for the potential distribution in several arrangements of the system are worked out, and the deflection characteristics and aberration figures are deduced. An experimental model is shown to produce results comparable with conventional cathode-ray-tube deflection systems. A.E.I. Research Laboratory

537.533.3

6259. ELECTRON-OPTICAL SYSTEMS WHOSE FIELDS ARE INDEPENDENT OF ONE COORDINATE. Yu.V.Vandakurov.
Zh. tekh. Fiz., Vol. 26, No. 11, 2578-94 (1956). In Russian.

The fields involved are either cylindrical or they have a symmetry of rotation. It is shown that, for electron-optical systems with fields of this kind, one of the two second-order differential equations determining the deviation of the particle path from the axial trajectory can be substituted by a first-order equation. The results obtained have been used for the study of fields whose electric potential is symmetrical with respect to the median plane, whereas their scalar magnetic potential is antisymmetrical with respect to that plane. The following fields have been investigated in more detail: (1) fields of the linear current, (2) fields of a spherical or cylindrical condenser, and (3) combinations of a heterogeneous magnetic field with the field of an electrical condenser. F.Lachman

537.533.33

6260. ON ASYMPTOTIC IMAGE DEFECTS. F.Lenz.
Optik, Vol. 14, No. 2, 74-82 (Feb., 1957). In German.

The determination of the aberrations of a system of electron lenses requires more than a simple combination of the aberrations of individual lenses. In an electron microscope, for example, electrons come under the influence of the projector lens before reaching the geometrical image position pertaining to the objective lens. The effect of this interaction is worked out rigorously and applied to the case of the "bell" field. It provides an explanation for discrepancies between earlier calculations of Liebmann and Glaser. A.E.I. Research Laboratory

537.533.331

6261. ON A MECHANICALLY ADJUSTABLE ELECTROSTATIC EINZEL LENS. B.Rajewsky and W.Lippert.
Optik, Vol. 14, No. 2, 72-3 (Feb., 1957). In German.

The normal method of altering magnification by changing the

potential of the middle electrode of an electrostatic lens involves certain difficulties. It is suggested instead that a lens comprising three cylinders should be used in the "einzel" condition, one cylinder being made capable of displacement in an axial direction.
A.E.I. Research Laboratory

537.533.331

6262. DIFFUSION PATTERNS IN ELECTROSTATIC IMMERSION LENSES. Yu.V.Vorob'ev.
Zh. tekh. Fiz., Vol. 26, No. 10, 2269-80 (1956). In Russian.

In the first part the author deals with a new mathematical treatment of the problem of how to solve the non-linear equation for the trajectory of beams of electrons leaving the cathode in the neighbourhood of the symmetry axes, in the case of immersion lenses, i.e. of an optical system where the source is placed in a strong electric field. In the second part an original set of results for the diffusion patterns of an arbitrary beam is obtained. G.Martelli

537.533.332 : 621.385.832.032.265.3

6263. ERRORS OF MAGNETIC DEFLECTION. I.
J.Haantjes and G.J.Lubben.
Philips Res. Rep., Vol. 12, No. 1, 46-68 (Feb., 1957).

Deals with the errors caused by magnetic deflection of the electron beam in a cathode-ray tube. It appears that image distortion, astigmatism, curvature of the image field and coma may occur corresponding to the errors of the third order in conventional optics. It will be shown that in most cases one may influence and even eliminate these errors by a suitable distribution of the deflecting field. The only error which can never be eliminated by a special field distribution is the error known as curvature of the image field. This error would not appear if the screen face of the tube coincided with the image field. However, the curvature of the image field is such that it is generally impossible to fulfil this condition. Therefore this error has to be taken into account in the design of cathode-ray tubes for television purposes. A.

537.533.35

6264. OBSERVATION OF DISLOCATIONS IN METALS BY MEANS OF MOIRÉ PATTERNS ON ELECTRON MICROGRAPHS.
D.W.Pashley, J.W.Menter and G.A.Bassett.
Nature (London), Vol. 179, 752-5 (April 13, 1957).

Moiré patterns are formed between overlapping parallel gratings with different spacings: d_1, d_2. The spacing of the moiré pattern is $S = d_1 d_2/(d_1 - d_2)$. This principle is applied to the study of the structure of thin single-crystal metal films by transmission electron microscopy. An evaporation technique is used to prepare bimetal specimenss of the following combinations, Au/Ni, Au/Co, Au/Cu, Au/Pd, Au/Pt, with their respective lattices parallel [(111) in the plane of the specimen]. Moiré patterns have been observed for all the pairs, the spacing varying from 35 A for Au/Pt [(02$\bar{2}$) reflections] to 5.3 A for Au/Ni [(42$\bar{2}$) reflections]. The moiré pattern is formed by a double diffraction mechanism and the secondary spectra associated with this have been observed. The "Bragg" angle of the secondary spectra is that to be expected from a grating with the moiré spacing. Optical analogues have been used to demonstrate that dislocations in either of the overlapping crystals will appear as "extra" planes in the moiré pattern. Dislocations are observed on the electron micrographs. A dislocation with Burgers vector in the plane of the specimen and perpendicular to the planes resolved has two "extra" planes associated with it. The technique overcomes the difficulties arising from resolution limitation encountered in the earlier studies of Menter (Abstr. 7031/1956) using the direct method for resolving crystal lattices and dislocations. The method is being applied to the study of alloy formation, order–disorder phenomena, the growth of oriented layers. It may also be used on an electron interferometer for measurement of inner potential. J.W.Menter

537.533.35 : 539.165.08

6265. SOME PROPERTIES OF A MODIFIED SOLENOID β SPECTROMETER WITH ZERO FIELD AT THE SOURCE.
Y.Ramberg and A.E.Blaugrund.
Rev. sci. Instrum., Vol. 28, No. 4, 286-7 (April, 1957).

The resolving power of a long magnetic lens using a field that rises linearly from a zero value at the source and becomes constant at a distance z_0 has been calculated as a function of z_0 for two emission angles 26.5° and 31°. For z_0 smaller than the radius of the spectrometer the resolving power remains nearly equal to that of a uniform field lens and then deteriorates quickly for values of z_0 greater than the radius of the spectrometer. The first-order spherical aberrations as well as the location of the ring focus and the detector are given graphically as functions of z_0. A.

537.533.74

6266. BACKSCATTERING OF POSITRONS.
L.Danguy and R.Quivy.
J. Phys. Radium, Vol. 17, No. 12, 1021-2 (Dec., 1956). In French.

Experiments using the β^+-radiation of Na^{22} and Zr^{65} indicate that the backscattering of positrons follows similar laws to that of electrons, but that the intensity of scattering under the same conditions is considerably less. A.O.Stanesby

537.533.74

6267. ELASTIC SCATTERING OF ELECTRONS. R.Zouckermann
J. Phys. Radium, Vol. 18, No. 2, 133-7 (Feb., 1957). In French.

Summary of basic theory, starting from the Rutherford formula and the Born approximation, and outlining Mott's relativistic treatment. N.M.King

537.533.74 : 539.166.74

6268. THE SELF-SCATTERING OF THE COMPTON RECOIL ELECTRONS PRODUCED BY Co^{60} GAMMA-RAYS.
T.Sidei, T.Higasimura and K.Kinosita.
Mem. Fac. Engng Kyoto Univ., Vol. 18, No. 4, 367-77 (Oct., 1956).

An experimental study of the angular distribution of the secondary electrons emerging from various thicknesses of Ag and Pb gave results which are explained in terms of the scattering in the metal of the electrons from the 1.2 MeV gamma-ray. Forward and backward scattering within 1.3 π steradian were measured for thicknesses of Al, Cu, Ag and Pb up to 600 mg/cm^3. The total intensity is suggested as a measure of the gamma-ray efficiency of the square-section counter used. This varied with the material of the walls and was found to have a minimum for $Z \cong 50$ and to be higher for Al than for Pb. E.J.Burge

537.533.74

6269. PROTON POLARIZABILITY CORRECTION TO ELECTRON–PROTON SCATTERING. S.D.Drell and M.A.Ruderman
Phys. Rev., Vol. 106, No. 3, 561-3 (May 1, 1957).

The contribution to observed electron–proton scattering cross-sections of the electron-induced polarization of the proton is estimated and found to be small for electron energies < 500 MeV. A

537.533.74

6270. POLARIZATION EFFECTS IN THE SCATTERING OF ELECTRONS AND POSITRONS ON ELECTRONS.
A.A.Kresnin and L.N.Rozentsvelg.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 353-8 (1957). In Russian.

Polarization phenomena arising in the scattering of electrons or positrons on electrons are considered. It is found that Moller scattering in magnetized foils can be used to analyse electron or positron beams. A

537.533.74 : 537.534.74

6271. BREIT'S EQUATION FOR ELECTRON–PROTON SCATTERING. H.Marschall.
Z. Phys., Vol. 147, No. 2, 247-52 (1957). In German.

A wave equation is being discussed for the treatment of the scattering of fast electrons by protons. Breit's equation is employed to which has been added the Pauli term in order to take into account the anomalous magnetic moment of the proton. E.W.Kellerman

537.533.75 : 537.562 : 537.591.2

6272. ENERGY LOSS OF A CHARGED PARTICLE TRAVERSING IONIZED GAS AND INJECTION ENERGIES OF COSMIC RAYS.
S.Hayakawa and K.Kitao.
Progr. theor. Phys., Vol. 16, No. 2, 139-48 (Aug., 1956).

The energy loss of a charged particle traversing an electron gas is calculated by taking the direct collisions with free electrons and the plasma excitation into account. The contributions from ions and neutral atoms are added and the resultant energy loss is given as a function of the degree of ionization. The energy loss is found to increase with the degree of ionization, to which excess loss is approximately proportional. The critical injection energy of cosmic rays, based on the Fermi mechanism of acceleration, is given. Its value is about 50% larger for 10% degree of ionization than for a neutral medium and nearly four times larger for a half-ionized medium. In the case of the solar production of cosmic rays the critical injection energy is below one MeV per nucleon, so that the secondary particles generated by nuclear reactions could be accelerated to cosmic ray energies. The mechanism of acceleration in a coronal region is proposed to explain the time delay of the cosmic-ray increase compared with the solar eruption as well as the energy spectrum of solar cosmic rays. A

537.533.79

6273. ON SPACE CHARGE WAVES. R.H.C.Newton.
J. Electronics, Vol. 2, No. 5, 441-50 (March, 1957).

Theoretical analysis of the behaviour of an electron beam in a uniform magnetic field, without making the usual assumption of neutralization by a positive space charge. A general wave-equation is derived, and various types of small perturbations are shown to give the same results as previous work using the positive ion neutralization assumption. Some qualitative remarks are made on the effects of "sausageing" and of large signals. J.Hawgood

537.533.79

6274. ORBITS OF AN ELECTRON IN STATIC ELECTRO-MAGNETIC FIELDS. I. G.Iwata.
Progr. theor. Phys., Vol. 15, No. 6, 513-22 (June, 1956).

Static electromagnetic fields in which the Hamilton–Jacobi equation of an electron is integrable by separation of variables are determined. The field for a perfect imaging system is rediscovered. A.

537.533.8

6275. SPECTRUM OF TARGET BREMSSTRAHLUNG AT SMALL ANGLES. A.Sirlin.
Phys. Rev., Vol. 106, No. 4, 637-45 (May 15, 1957).

The combination of Schiff's energy–angle distribution for the radiated photons and a Gaussian-like theory of multiple scattering for the incident electron is studied. The emphasis here is placed on a detailed consideration of the influence of screening as expressed in the Schiff's theory. An expression for the forward radiation is first developed, which is valid for values of $\lambda \ll 1$ and for any value of ρ (λ and ρ being parameters which essentially measure the importance of multiple scattering and screening, respectively). This result shows that the deviations of the actual forward spectrum from the integrated spectrum of the intrinsic distribution are appreciable even for small values of λ, the corrections being largest for complete screening and negligible for no screening. The case of complete screening is then studied exactly both for the forward radiation and the angular distribution. The latter results show that the integrated spectrum approximation is a good one when $\theta > \sim \mu/E_0$ and $\lambda \ll 1$. In a particular case, the theory predicts that the angular distribution (normalized to unity at $\theta = 0$) is somewhat broader for complete screening than for no screening. An exact treatment of the forward radiation is given for the cases of complete screening and no screening. Finally, an expression is developed, which yields the same result as the exact treatment for complete screening and no screening and provides a good approximation for intermediate screening. A.

537.534

6276. VARIABLE-ENERGY PARTICLE ACCELERATORS. J.W.Gallop.
Nature (London), Vol. 179, 492 (March 2, 1957).

A linear accelerator using a travelling wave in a helical waveguide is proposed. Curves are given showing that the phase velocity of the wave varies nearly linearly with the pitch/radius ratio of the helix and also varies with frequency. Variation of frequency would then vary the final particle energy. A narrow velocity spectrum and absence of extraction problems gives an advantage over the cyclotron. J.H.Fremlin

537.534

6277. NON-LINEAR THEORY OF BETATRON OSCILLATIONS IN A STRONG-FOCUSING SYNCHROTRON. Yu.F.Orlov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 316-22 (1957). In Russian.

A new method for investigation of betatron resonances has been developed. Parametric resonances are investigated. A.

537.534.3

6278. ALTERNATING-GRADIENT MAGNETIC SPECTROMETER. H.J.Martin and A.A.Kraus.
Rev. sci. Instrum., Vol. 28, No. 3, 175-8 (March, 1957).

The spectrometer consists of two magnetic lenses that deflect the analysed particles through a total angle of 30°. It is able to analyse protons with energies up to 6 MeV and has a solid angle of 0.012 sterad and a momentum resolution $R = p/dp = 77$ for 0.5mm exit slit. The distance between the source and image positions is 85 cm. A.

537.534.3

6279. A SYSTEM FOR THE RAPID REDUCTION OF MASS SPECTROMETRIC DATA. B.K.Fritts and C.G.Peattie.
Analyt. Chem., Vol. 28, No. 10, 1518-20 (Oct., 1956).

The system described consists of four units: (i) the "Contact Telereader", (ii), the "Teleducer", (iii), the "Program Unit" and (iv), the "Flexowriter". Unit (i) has a viewing table on which the spectrum is laid; a horizontal wire moved to the top of a peak sets up a voltage proportional to peak height. This is converted to digits by (ii) and set out in sequential form by (iii) which can also handle supplementary information. The output data given by (iv) may be in punched tape or card form, as well as in typed columns, and is suitable for processing in electronic computers. The process is faster and no less accurate than conventional methods, and should be particularly suitable for spectra of high molecular weight. Comparative tables of results using this system and manual methods are quoted and described. N.M.King

537.534.3

6280. SOME DESIGN DATA FOR A NONMAGNETIC RADIO-FREQUENCY MASS SPECTROMETER. J.Dekleva and M.Ribarič.
Rev. sci. Instrum., Vol. 28, No. 5, 365-9 (May, 1957).

The current efficiency and the half-width of the resonance curve in a radiofrequency mass spectrometer are discussed in relation to the energy gain in the one-, two-, and three-stage tube. Both quantities are calculated and measured for two different analysing systems; in the first case with a retarding barrier and secondly with a deflecting field. The measurements show that there is, instead of the theoretical relation between the resolving power (r.p.) and current efficiency, $\text{r.p.} \cong E_{max}^{-1}$ with a retarding field as an analyser, a less useful one, $\text{r.p.} \cong E_{max}^{-1/5}$. But in the case with a deflecting field as an analyser the theoretical relation between the resolving power and the current efficiency, $\text{r.p.} \cong E_{max}^{-1/3}$, and the measured relationship are the same. A.

537.534.74

6281. ELASTIC PROTON–PROTON SCATTERING AT 460 MeV. M.G.Meshcheryakov, N.P.Bogachev, B.S.Neganov and E.V.Piskarev.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 6, 955-8 (1954). In Russian.

Counter telescopes in coincidence were used to detect the scattering events, and the differential cross-section was measured with good accuracy. Its value (in the centre-of-mass system) varies slightly with variation of angle, i.e. $\sigma(30^0)/\sigma(90^0) = 1.14 \pm 0.06$. The total cross-section (after small-angle extrapolation) is found to be $\sigma = 22.10^{-27}$ cm^2. G.Martelli

537.534.74

6282. ANOMALOUS VARIATION OF THE PROTON–PROTON ELASTIC SCATTERING CROSS-SECTION IN THE 460-660 MeV REGION. M.G.Mershcheryakov, B.S.Neganov, L.M.Soroko and I.K.Vzorov.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 6, 959-61 (1954). In Russian.

Occurrence of inelastic scattering events in the p–p interactions and their contribution to the increase of the ratio $\sigma(30^0)/\sigma(90^0)$ of elastic scattering differential cross-sections with increasing energy from 460 up to 660 MeV is considered, and discussed in this critical survey of the results obtained by the authors (and their coworkers) and other groups. G.Martelli

537.534.74

6283. SCATTERING OF PROTONS WITH ENERGIES 460-660 MeV BY PROTONS.
Ya.M.Selektor, S.Ya.Nikitin, E.G.Bogomolov and S.M.Zombovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 6, 967-9 (1954). In Russian.

To identify the p–p elastic scattering events both protons participating in the interaction were recorded, so as to exclude the background counts due to the products of inelastic interactions. The total intensity of the beam was measured by means of an ionization chamber. The scatterers consisted alternatively of a layer of paraffin and an equivalent one of carbon, and the scattering in hydrogen was determined by means of the difference method. Differential cross-sections from 20° to 90° in the centre-of-mass system are given for protons of 460, 590 and 660 MeV. G.Martelli

537.534.74

6284. POLARIZATION IN PROTON–PROTON SCATTERING AT 130, 170, AND 210 MeV.
E.Baskir, E.M.Hafner, A.Roberts and J.H.Tinlot.
Phys. Rev., Vol. 106, No. 3, 564-8 (May 1, 1957).

Using a 90% polarized proton beam, the polarization in p–p scattering at centre-of-mass angles has been measured between 20° and 81° at 130 MeV, between 31° and 82° at 170 MeV, and between 14° and 112° at 210 MeV. The first two of these measurements are consistent with data previously published; the third involves an energy in the neighbourhood of which earlier detailed work has not been done. The measurements are fitted by functions of the form

$$P(\theta)\sigma(\theta) = \sin\theta \cos\theta \sum_{n=0}^{\kappa} b_{2n} \cos^{2n}\theta, \quad \text{where } \kappa = 0, 1, \text{ or } 2.$$

At 210 MeV, a three-parameter least-squares fit yields $b_0 = (2.78 \pm 0.16)$ mb/sterad, $b_2 = (-2.24 \pm 0.17)$ mb/sterad, and $b_4 = (2.96 \pm 0.77)$ mb/sterad. Statistical analysis of the data at 210 MeV indicates that F-wave effects, and in particular a non-vanishing b_4, are required for description of the scattering. A.

537.534.74

6285. DIFFUSE-SURFACE OPTICAL MODEL ANALYSIS OF ELASTIC SCATTERING OF 17 AND 31.5 MeV PROTONS. M.A.Melkanoff, J.S.Nodvik, D.S.Saxon and R.D.Woods. Phys. Rev., Vol. 106, No. 4, 793-801 (May 15, 1957).

Differential cross-sections for the elastic scattering of 17 and 31.5 MeV protons by various nuclei have been analysed according to the diffuse-surface optical model of the nucleus using a central interaction potential of the form $-(V + iW)/\{1 + \exp[(r - R)/a]\}$. Calculated curves of the ratio of the differential to the Rutherford cross-sections are presented and compared with experimental values. The adopted values of the four parameters of the model are those which either give best agreement with experiment or, insofar as ambiguities exist, permit the interaction radius R to be expressed as $R_0A^{1/3}$ with R_0 constant throughout most of the periodic table. The average values of the parameters chosen in this way were found at 17 MeV to be as follows: real part of the nuclear potential V = 47 MeV, imaginary part of the nuclear potential W = 8.5 MeV, nuclear radius constant $R_0 = 1.33 \times 10^{-13}$ cm, surface rounding parameter $a = 0.5 \times 10^{-13}$ cm. A similar analysis at 31.5 MeV gave V = 35.5 MeV, W = 15.5 MeV, $R_0 = 1.33 \times 10^{-13}$ cm, $a = 0.55 \times 10^{-13}$ cm. Ambiguities in the quoted values due to compensating effects of changes in V and R_0 are discussed. For intermediate and heavy nuclei like Ag and Pt, good agreement can be obtained at 17 MeV for values of R_0 ranging from 1.2 to 1.4×10^{-13} cm, but for lighter elements like Co the range of R_0 is much more restricted. Theoretical curves of the reaction cross-section are presented at 17 and 31.5 MeV based on quoted values of the model parameters. It is pointed out that accurate experimental measurements of this quantity may possibly resolve the ambiguity. A.

537.534.74

6286. SCATTERING OF FAST PROTONS ON PROTONS. D.I.Blokhintsev. Zh. éksper. teor. Fiz., Vol. 32, No. 2, 347-9 (1957). In Russian.

It is shown that the main term in the interaction of two protons with J = 0 should have a singularity of the order of $1/r^3$. A.

537.534.8

6287. EMISSION OF NEGATIVE IONS FROM METALLIC SURFACES BOMBARDED WITH POSITIVE HYDROGEN IONS. I.M.Mitropan and V.S.Gumenyuk. Zh. éksper. teor. Fiz., Vol. 32, No. 2, 214-22 (1957). In Russian.

Results are presented of an experimental study of secondary negative ion emission from aluminium, stainless steel and copper targets bombarded by 200-1000 keV hydrogen and deuterium ions. A.

537.534.8

6288. INVESTIGATION OF SLOW ELECTRON EMISSION INDUCED BY HIGH-ENERGY PROTONS. E.S.Mironov and L.M.Nemenov. Zh. éksper. teor. Fiz., Vol. 32, No. 2, 269-73 (1957). In Russian.

The method of investigation is described. The emission coefficients γ_1 and γ_2 for aluminium and nickel in the energy range from 2 to 7.3 MeV are presented. A.

537.534.9

6289. NEW COLLISION THEORY OF CATHODE SPUTTERING OF METALS AT LOW ION ENERGIES. E.B.Henschke. Phys. Rev., Vol. 106, No. 4, 737-53 (May 15, 1957).

Cathode sputtering is conceived as being produced by purely mechanical collisions between the impinging ions and surface atoms of the target. Energy is lost during the collisions by excitation of Debye waves in the lattice. The collisions are assumed to occur as between perfectly elastic spheres with radii determined by the largest closed electronic shells of the ion and the target atom. Only upper surface atoms of the target can be sputtered; the ejection requires that the momentum transferred to an upper surface atom must have a component in normal outward direction and the transferred energy be larger than its binding energy to the lattice, which is assumed to equal the heat of vaporization. With the introduction of a dissipation coefficient, which determines the energy loss during the collision, formulae for the threshold energies at oblique and normal ion incidence and a sputtering rate formula for normal ion incidence at low ion energy have been derived. Experimental data on sputtering are in agreement with the derived formulae. From the derivation of the sputtering rate formula it can be concluded that the threshold energies must be roughly proportional to the squares of the collision radii of the target atoms. This implies a periodicity of the threshold energies within the periods of the periodic system, which has been evidenced by plotting experimental data on threshold energies for 26 metals v. atomic number. A.

DISCHARGE TUBES. COUNTERS 537.54

537.542

6290. SEWING-NEEDLE PROPORTIONAL COUNTER. A.H.Benade and R.E.Chrien. Amer. J. Phys., Vol. 25, No. 5, 313-17 (May, 1957).

A simple proportional counter made from common materials, and supplied with high voltage by a circuit made from automotive ignition parts, is described, and investigated. Alpha-particles from Po^{210} are shown to give up to 25 V pulses, while beta rays from Cs^{137} produce signals with amplitudes up to 2 volts without the use of any external amplification. These pulses are readily heard with headphones, or amplified by standard public-address equipment. A.

537.542

6291. ON AN INCREASED BACKGROUND EFFECT IN NEEDLE COUNTERS. H.Drost and H.Pupke. Naturwissenschaften, Vol. 43, No. 18, 418 (1956). In German.

A brief note on spurious counts, with a general discussion on the effects involved. Data are shown for an argon—oxygen counter, and the counting rate is plotted as a function of oxygen partial pressure. J.D.Craggs

537.542

6292. STATISTICS OF SPURIOUS PULSES FROM HALOGEN-QUENCHED G-M TUBES. W.G.Egan. Rev. sci. Instrum., Vol. 27, No. 11, 968-9 (Nov., 1956).

Briefly describes a method for the observation of the spurious pulses following the initial pulse in counter tubes. Curves are shown relating the number of spurious pulses in a train to the frequency of occurrence of such a train. There are differences in the behaviour of halogen and organic-vapour quenched counters. Details of five different types of tubes are given. J.D.Craggs

537.542 : 539.16.08

6293. THE BACKGROUND OF COUNTERS AND RADIOCARBON DATING. A.Moljk, R.W.P.Drever and S.C.Curran. Proc. Roy. Soc. A, Vol. 239, 433-45 (April 9, 1957).

In order to compare the efficiency of different counting arrangements for radiocarbon dating the use of a factor of merit $M = s_0/\sqrt{b}$, where s_0 is the counting rate from a fresh carbon sample and b the background counting rate, is suggested. In standard low-activity equipment with a Geiger or proportional counter surrounded by a ring of Geiger counters in anticoincidence, the residual background is mainly due to the detection of secondary particles produced in the wall of the counter by uncharged radiations. A new type of proportional counter, in which this wall effect is reduced, is described. The counter is fitted with a ring of internal shielding counters separated only by a number of cathode wires from the main central counter. The operation of this counting equipment is discussed, and it is shown that the background of 2.2 counts/min obtained under normal operating conditions in a sensitive volume of 5.6 litres is due mainly to the absorption of uncharged radiations in the gaseous sample itself. A.

537.542 : 539.16.08

6294. FURTHER ANALYSIS OF THE NEUTRON COMPONENT OF THE BACKGROUND OF COUNTERS USED FOR ^{14}C AGE MEASUREMENTS. H.de Vries. Nuclear Physics, Vol. 3, No. 1, 65-8 (March, 1957).

The background of counters, used for C^{14} age measurements, has been reduced appreciably by a special arrangement of blocks of paraffin wax (mixed with boric acid) inside the iron shield. The background could be divided into a constant fraction, probably due to radioactive contamination of the counter, and a fraction, depending on the barometric pressure, due to locally produced neutrons. The neutron background has been reduced by a factor of about 7; the barometer effect was 10% of the neutron component per cm Hg in all arrangements studied. The relative increase of the neutron component in the C^{14} counter during the solar flare of February 23 has been the same as in the neutron monitor. A.

537.542 : 537.311.33

6295. MECHANISM OF PULSE FORMATION IN SEMICONDUCTING CRYSTAL COUNTERS. S.M.Rŷvkin.
Zh. tekh. Fiz., Vol. 26, No. 12, 2667-83 (1956). In Russian.

The "ionization chamber" analogy is applicable only to insulators and does not fit the observed performance of semiconducting crystal counters, particularly with regard to the so-called "amplification effect" in which the observed charge exceeds that due simply to carriers liberated by the incident radiation. Another "anomaly" is the enhancement observed in CdS counters under a steady blue or green background illumination. A mechanism is suggested which takes account of the equilibrium carrier density. Approximate calculations are made of the performance to be expected for a given material in terms of its conductivity and carrier lifetime. J.B.Arthur

537.542 : 539.185.08

6296. SLOW NEUTRON DETECTION IN PRESENCE OF GAMMA-RADIATION. T.Domański.
Acta phys. Polon., Vol. 15, No. 5, 351 (1956).

The detector is a photomultiplier tube coated with a layer of ZnS(Ag) and a layer of natural boron. $B^{10}(n,\alpha)$ scintillations are distinguished from pulses generated by gamma-rays striking the multiplier electrodes, by their longer duration. R.S.Pease

537.542 : 539.16.08

6297. THE INFLUENCE OF METHYL ALCOHOL ON THE LUMINESCENCE CHARACTERISTICS OF SOLUTIONS USED FOR SCINTILLATION COUNTERS. A.Kuhn and J.Mojžíš.
Czech. J. Phys., Vol. 6, No. 4, 401-5 (Aug., 1956). In German.

Up to 30% methyl alcohol is introduced into 90.5% solution of p-terphenyl in toluene to obtain a measurement of its C^{14} content. The efficiency is claimed to be ≈ 18.5 times that of the Libby counters (Abstr. 1276/1953) for comparable content of carbon. G.F.J.Garlick

537.542 : 539.16.08

6298. A STABLE, LOW-BACKGROUND, HIGH-EFFICIENCY SCINTILLATION COUNTER FOR ANALYSIS OF LOW LEVELS OF RADON CONCENTRATED BY ADSORPTION ON CHARCOAL. H.F.Lucas, Jr.
Radiology, Vol. 68, No. 2, 258-9 (Feb., 1957).

An improvement in counting performance over earlier types is obtained by careful design of the counter. The counter shell is of steel and the end window of quartz coated with a transparent conducting layer of tin, as this overcomes local concentration of radon decay products through charges induced from the photomultiplier. For optimum pulse height the counter is coated inside with silver-activated zinc sulphide of 20 mg/cm² thickness. The system is sensitive to 10^{-14} c of radon or, using charcoal adsorption, 10^{-16} c of radon per litre of air. L.E.Mussell

537.542

6299. TOTAL ABSORPTION ČERENKOV COUNTER. W.B.Jones, H.R.Kratz and J.Rouvina.
Rev. sci. Instrum., Vol. 28, No. 3, 167-75 (March, 1957).

A Cherenkov counter is described for detecting and measuring the energy of X-rays in the 50 to 300 MeV range. The incident X-ray produces a photon–electron shower in a cylinder of carbon tetrachloride, and the Cherenkov radiation emitted by the electrons in the shower is a measure of the X-ray energy. The cylinder of carbon tetrachloride is 12 in. dia. by 36 in. long. The Cherenkov radiation is measured with seven 5 in. photomultiplier tubes mounted at one end of the cylinder. The pulse distribution from the counter has a $\sigma/\bar{x}$ which varies from 0.146 at 217 MeV to 0.216 at 47 MeV. The energy response of the counter is linear up to 217 MeV, the highest energy at which measurements have been made. A.

537.542

6300. BETA SPECTROSCOPY USING A DIFFUSION CLOUD CHAMBER. A.A.Silvidi.
Amer. J. Phys., Vol. 25, No. 3, 159-64 (March, 1957).

The quantitative usefulness of an inexpensive chamber particularly adaptable for small colleges is shown. In particular, the beta spectrum of Pm^{147} was obtained and compared with the spectrum which had been obtained by the use of an intermediate-image type spectrometer. The end-point energy as obtained here is 231 keV for a difference of 3.5% as compared with published values of 233 keV. A.

537.542

6301. DETECTION OF TRACKS OF IONIZING HIGH-ENERGY PARTICLES FROM AN ACCELERATOR BY MEANS OF A PROPANE BUBBLE CHAMBER. G.A.Blinov, Yu.S.Krestnikov and I.I.Pershin.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 6, 929-30 (1954). In Russian.

Successful operation of the first propane-filled bubble chamber is reported. The device, of the "clean" type, consisted of a strong-walled cylindrical glass vessel (16 mm diameter, 55 mm long) connected through a capillary tube to the expansion system. The operation conditions are discussed and a few good photographs are shown. G.Martelli

537.543

6302. STUDY OF THE TRIODE IN THE ELEMENTARY LABORATORY. E.P.Clancy.
Amer. J. Phys., Vol. 25, No. 3, 204-5 (March, 1957).

It is considered that the study of a triode valve, as described in most general introductory courses in practical physics, leaves much to be desired; an improved type of wired circuit, enabling the static characteristic curve and the voltage amplification factor to be determined in one laboratory period, is described. J.S.G.Thomas

IONIZATION. THERMIONICS 537.56/.58

537.562

6303. ON THE PLASMA-[PROBE] SPACE CHARGE SHEATH TRANSITION REGION. J.Wilhelm.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 288-96 (1956). In German.

Extending Boyd's (Abstr. 5016/1950; 9560/1951) interpretation, the influence of the probe space charge sheath on the pressure is examined using Hornbeck's mobility values (Abstr. 1916/1952). Further necessary trends in theory are indicated. A.E.D.Heylen

537.562

6304. THE KINETIC THEORY OF FEEBLY IONIZED HOMOGENEOUS PLASMAS. III. THE COLLISION OPERATOR IN THE CASE OF AN IMPERFECT LORENTZ GAS. M.Bayet, J.L.Delcroix and J.F.Denisse.
J. Phys. Radium, Vol. 17, No. 11, 923-30 (Nov., 1956). In French.

For Pt II, see Abstr. 7080 (1955). A new collision operator is studied, with special reference to the form of the electron energy distribution. J.D.Craggs

537.562

6305. THE KINETIC THEORY OF FEEBLY IONIZED HOMOGENEOUS PLASMAS. IV. THE STUDY OF THE DEVELOPMENT OF THE ISOTROPIC PART OF THE DISTRIBUTION FUNCTION. M.Bayet, J.L.Delcroix and J.F.Denisse.
J. Phys. Radium, Vol. 17, No. 12, 1005-9 (Dec., 1956). In French.

For Pt III, see preceding abstract. Particular attention is paid to an interaction force varying as $1/r^5$ for electron–molecule effects. Comparisons are drawn with various forms of discharge, whose relevant parameters are tabulated. J.D.Craggs

537.564

6306. EFFECT OF GASEOUS IMPURITIES ON THE FIRST TOWNSEND COEFFICIENT IN HYDROGEN. H.A.Blevin, S.C.Haydon and J.M.Somerville.
Nature (London), Vol. 179, 38-9 (Jan. 5, 1957).

Experimental values obtained for α in uniform fields, when $E/p > 50$ V cm^{-1} (mm Hg)$^{-1}$, are discussed in relation to results obtained by other authors; it is concluded that small amounts of the common gaseous impurities have little effect in this range. J.Dutton

537.564

6307. ON THE CROSS-SECTION OF FLUORINE ATOMS FOR ELECTRON COLLISION. H.Maecker.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 441-6 (1956). In German.

Measurements of the temperature and electron density distribution in a cylindrical high-power arc in SF_6 lead to a value of 7×10^{-16} cm² for the cross-section. This value is found to fit well on a curve of Ramsauer cross-section v. number of valence electrons, which shows that the cross-section falls continuously from alkalies to noble gases. J.Dutton

537.564 : 537.525 : 537.523

DRY AIR IONIZATION AT 50 c/s. See Abstr. 6209

537.565

6308. ON THE MOBILITY OF ELECTRONS IN NON-ISOTHERMAL PLASMAS. K.Wojaczek and K.Rademacher.
Ann. Phys. (Leipzig), Vol. 18, No. 5-8, 237-50 (1956). In German.

Probe characteristics were taken in argon at pressures of 1-3 mm Hg in tubes of about 12 cm diameter. Data for radial variations of electron density and for electron temperatures (up to about 22 000°K) are given. Mobilities are deduced and plotted against electron temperatures. J.D.Craggs

537.583

6309. PULSED THERMIONIC EMISSION FROM THORIA CATHODES. D.Déjardin, G.Mesnard and R.Uzan.
Cahiers de Phys., No. 74, 1-21 (Oct., 1956). In French.

The emission decay during pulses of some milliseconds duration was recorded. Assuming a semiconducting model the equation for the drop was established. This gives some information on the energy levels and on the donor mobilities. A.H.W.Beck

COSMIC RAYS 537.591

537.591

6310. ZENITH ANGLE SENSITIVITY OF A CUBICAL MESON TELESCOPE. N.R.Parsons.
Rev. sci. Instrum., Vol. 28, No. 4, 265-6 (April, 1957)

Diagrams are presented showing the variation of relative sensitivity with zenith angle for a vertically directed cubical meson-telescope of the type recommended as standard equipment for the International Geophysical Year. A.

537.591.1

6311. RELATIVE ABUNDANCES OF DIFFERENT CHARGE GROUPS OF HEAVY PRIMARY COSMIC-RAY NUCLEI.
J.H.Noon, A.J.Herz and B.J.O'Brien.
Nature (London), Vol. 179, 91 (Jan. 12, 1957).

Preliminary note on a high altitude (110 000 ft) emulsion experiment to determine the abundance of light nuclei ($3 \leq Z \leq 5$) in the primary cosmic rays. Abundances of light and heavy elements relative to medium (extrapolated to the top of the atmosphere) are found to be greater than the relative cosmic abundances obtained from astrophysical data. R.H.W.Johnston

537.591.1

6312. ON THE ACCELERATION OF COSMIC RAY PARTICLES. W.B.Thompson.
Phil. Mag., Vol. 45, 1210-11 (Nov., 1954).

The possibility of rate of acceleration 100 times greater than that of Fermi's theory (Abstr. 3291/1949; 5212/1954; see also 6708/1954) is indicated by consideration of the scattering of particles by small irregularities, and acceleration by large irregularities, in the magnetized interstellar clouds.

537.591.15

6313. ON THE DEPENDENCE OF EXTENSIVE AIR SHOWERS ON THE ALTITUDE. G.T.Zatsepin and L.I.Sarȳcheva.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 6, 951-4 (1954). In Russian.

The number of showers with a given number of particles and its dependence on the energy spectrum of the primary radiation are calculated as a function of the atmospheric depth. G.Martelli

537.591.15

6314. ON THE SPATIAL CHARACTERISTICS OF THE NUCLEAR-ACTIVE COMPONENT OF EXTENSIVE SHOWERS OF COSMIC RAYS. I.L.Rozental'.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 6, 963-6 (1956). In Russian.

Radial distribution of the particles in extensive air showers is calculated, when the energy spectrum of secondary particles generated in the collisions of primary particles with nuclei of the atmosphere is taken into account. G.Martelli

537.591.15

6315. STUDY OF EXPLOSIVE SHOWERS FORMED BY COSMIC PARTICLES OF HIGH ENERGY. V.V.Alpers, I.I.Gurevich, V.M.Kutukova, A.P.Mishakova, B.A.Nikol'skiĭ and L.V.Surkova.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 1, 33-6 (1957). In Russian.

Results are presented of an analysis of 29 showers which were recorded in an emulsion chamber (camera) exposed to cosmic radiation at the height of 27 km. Z.Krasucki

537.591.15

6316. CLOUD CHAMBER ANALYSIS OF COSMIC-RAY SHOWERS UNDER 10 TO 23 cm OF LEAD.
P.K.Sen Choudhury and S.N.Sengupta..
Indian J. Phys., Vol. 30, No. 9, 455-63 (Sept., 1956).

A counter-controlled cloud-chamber study of different types of showers in Pb, under 10 to 23 cm has been made to investigate the controversial existence of higher maximum in Rossi curve and its probable origin. The chamber and the counters in triple coincidence were specially arranged to detect the formation of a charged pair or particle by the decay or dissociation of an unstable neutral particle in air under the Pb absorber. The triple coincidence frequency rises by about 28% over the background under about 16 cm of Pb. Analysis of the shower photographs, however, shows that this rise is largely due to a single-charged particle coming from the top absorber which by subsequent knock-on process or otherwise produces the triple coincidence. These singles may account for about 12% of the total rise. About 10% of the total rise may be attributed to mixed meson and meson showers. Analysis of shower photographs by the neutral component shows that out of about a thousand photographs only one penetrating pair was obtained with its apex in air under 16 cm of Pb and this may be due to a V-type of decay. A.

537.591.15

6317. A NEW APPROACH TO THE CASCADE THEORY.
A.Ramakrishnan and S.K.Srinivasan.
Proc. Indian Acad. Sci. A, Vol. 44, No. 5, 263-73 (Nov., 1956).

An alternative treatment of the cosmic-ray cascade theory is suggested. Cascades are treated in terms of the energies of particles at the time of their production rather than of all the particles at any particular depth. This approach leads to a convenient asymptotic theory for large thicknesses and simplifies the interpretation of events in nuclear emulsions. A.J.Egginton

537.591.15

6318. STRUCTURE OF THE PERIPHERY OF EXTENSIVE ATMOSPHERIC COSMIC-RAY SHOWERS.
Yu.N.Antonov, Yu.N.Vavilov, G.T.Zatsepin, A.A.Kutuzov, Yu.V.Skvortsov and G.B.Khristiansen.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 227-40 (1957). In Russian.

An investigation of the lateral distribution of various components of the periphery of extensive showers (200-800 m from the axis) was carried out. The data indicate that the contribution of the shower periphery to the total shower particle flux is significant. The lateral distribution of the electron component at the periphery can be explained by means of multiple Coulomb scattering theory. Coulomb scattering also plays an important role in the divergence of the penetrating particles (μ-mesons); however the angles of emission of $\pi^{\pm}$-mesons which give rise to μ-mesons emitted at large angles in elementary act of nuclear-cascade processes can apparently also lead to this type of divergence of μ-mesons. An investigation of the intensity of the primary cosmic radiation at very high energies (10^{16}-10^{17} eV) was also carried out. A.

537.591.15

6319. THE EQUILIBRIUM SPECTRUM OF ELECTRONS AND PHOTONS WITH ACCOUNT OF SCATTERING. I.P.Ivanenko.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 333-7 (1957). In Russian.

An exact solution of the equation for the equilibrium spectrum of electrons and photons has been obtained with account of scattering that is, an expression has been obtained for the angular and energy distribution of particles at the shower maximum in heavy elements. A

537.591.15

6320. ENERGY SPECTRUM OF CASCADE PHOTONS IN LIGHT MATERIALS. I.P.Ivanenko and M.A.Malkov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 150-1 (1957). In Russian.

Calculations analogous to those previously given for heavy materials (Abstr. 510/1957 and preceding abstract); results for air are presented in two tables. W.O.Lock

537.591.5

6321. ON THE TEMPERATURE EFFECT OF THE HARD COMPONENT OF COSMIC RAYS. L.I.Dorman.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 1, 49-52 (1954). In Russian.

Duperier's theory of this effect does not, in general, lead to values of the temperature coefficient which are in agreement with experiment. S.Chomet

537.591.5

6322. SUGGESTION CONCERNING THE NATURE OF THE COSMIC RAY CUTOFF AT SUNSPOT MINIMUM. F.Hoyle.
Phys. Rev., Vol. 104, No. 1, 269-70 (Oct. 1, 1956).

It is shown that the earth's magnetic field, and the interstellar magnetic field are of the same order of magnitude ($\sim 3 \times 10^{-4}$ gauss) at a distance from the earth of about 10 radii. Cosmic rays initially attached to the lines of force of the interstellar field must make a transition to the lines of force of the earth's field if they are to reach the earth's surface. If it is assumed that the radius of the orbit of the particle must be $\geq$ 10 earth radii for such a transition to be possible, and that the interstellar field may be raised to $\sim 10^{-3}$ gauss by compression of interstellar gas in the gravitational field of the sun, then a low energy cutoff at proton energy $\sim$ 1 BeV is obtained. P.Rothwell

537.591.5

6323. INTENSITY VARIATION OF VERTICAL COSMIC-RAY AIR SHOWERS. K.Y.Shen and S.F.Singer.
Phys. Rev., Vol. 106, No. 3, 555-7 (May 1, 1957).

A new experimental approach has been studied for measuring the sidereal time variation of the high-energy cosmic radiation. The apparatus consists of an "air-shower telescope" using only six small counter tubes and an "extensive" tray of G.M. tubes. The apparatus is sensitive to vertical showers and discriminates against showers with (projected) zenith angle greater than 10^0; this directional efficiency is calculated to be about 90% and has been verified experimentally. In subsidiary experiments, the apparatus has been used to measure the zenith angle dependence of air showers. An arrangement of counters can therefore be set up to detect only vertical showers of high energy. Preliminary results show a counting rate of 1 per 3 hours per recording station for vertical extensive air showers of energy $\geq 10^{15}$ eV. The barometric coefficient has been determined as (9 ± 4)% per cm Hg; however, no statistically significant time variation has as yet been detected. The recording rate can be increased and better statistics obtained by increasing the number of recording setups. A.

537.591.5

6324. CHANGES IN THE HIGH-LATITUDE EAST–WEST ASYMMETRY OF COSMIC RAYS. R.M.Jacklyn and A.G.Fenton.
Phys. Rev., Vol. 106, No. 4, 809-11 (May 15, 1957).

A large long-term decrease in the east–west asymmetry has been observed at Hobart ($\lambda = 52^0$S; near sea-level). This is apparently related to the level of solar activity. In 1950 the asymmetry amounted to $\alpha = 0.0246 \pm 0.0022$, while in 1954 (a year of sunspot minimum) it was only 0.0108 ± 0.0016. It is shown that the decrease cannot be explained by changes in the parameters involved in the Johnson theory of the high-latitude east–west asymmetry, leading to the conclusion that the primary particles capable of producing a sea-level penetrating component at these latitudes are not completely isotropically distributed when they reach the upper atmosphere. The asymmetry is to be regarded as a very sensitive indicator of such anisotropy. A.

537.591.5

6325. THE EFFECT OF HUMIDITY ON THE COSMIC-RAY INTENSITY AT THE GROUND LEVEL. F.Rahman and J.Choudhary.
Pakistan J. sci. Res., Vol. 8, No. 4, 171 (Oct., 1956).

It is claimed that fluctuations of relative humidity, a decrease from 85.80% to 75.35% within six hours and thirty minutes, have been accompanied by an increase of a telescope counting rate from 44 per hour to 47 per hour. E.W.Kellermann

537.591.5

6326. THE SOLAR ECLIPSE OF 20th JUNE, 1955 AND ITS EFFECT ON COSMIC-RAY INTENSITY AT DACCA.
F.Rahman and J.Choudhary.
Pakistan J. sci. Res., Vol. 8, No. 4, 171-2 (Oct., 1956).

It is claimed that the counting rate of a triple-coincident counter telescope showed a decrease from a rate of 46 per hour by 26% during the solar eclipse of June 20, 1955. E.W.Kellermann

MAGNETISM 538

538.082 : 548

6327. ON THE DETERMINATION OF MAGNETOCRYSTALLINE ANISOTROPY CONSTANTS FROM TORQUE MEASUREMENTS.
J.S.Kouvel and C.D.Graham, Jr.
J. appl. Phys., Vol. 28, No. 3, 340-3 (March, 1957).

According to simple theory, torque measurements on cubic single single-crystal disks should give values for the crystal anisotropy constants, K_1 and K_2, that are independent of field above some minimum saturating field. Experiments on {100} and {110} disks of $3\frac{1}{4}$% silicon–iron show that this theory is inadequate. In a more refined theory it is assumed that the edges of the disk are not saturated even in high fields. The observed increase in the peak values of the torque with increasing field can be attributed to a very small variation of the net magnetization I as the disk is rotated in the field. This variation must be such that I is largest in the hard directions of magnetization and smallest in the easy directions. Direct observation of the domain patterns on a {100} disk appears to confirm these assumptions. For both {100} and {110} disks, K_1' (the effective value of K_1) varies as $1\text{-}c/\sqrt{H}$ over the range 1000 to 20 000 oersteds. The corresponding K_2' values for the {110} disk show a more complicated dependence on H. Values of K_1' found from torque peaks differ somewhat from those obtained from torque slopes; the difference between the smaller K_2' values is much more serious. The discrepancy is attributed to the particular way in which I varies with disk rotation. A.

538.082

6328. IMPROVEMENT TO THE SUCKSMITH BALANCE.
B.S.Chandrasekhar.
Rev. sci. Instrum., Vol. 27, No. 11, 967-8 (Nov., 1956).

Small floats, completely immersed in oil, are used to counterbalance the weight of the suspension, specimen and accessories. The sensitivity of the balance can be increased considerably and a much wider latitude in the dimensions of the specimen is possible. A.E.De Barr

538.082

6329. COMPENSATION OF THE EARTH'S MAGNETIC FIELD.
G.G.Scott.
Rev. sci. Instrum., Vol. 28, No. 4, 270-3 (April, 1957).

A system is described for producing a highly homogeneous, variable, and directable magnetic field. This system, which was used in gyromagnetic ratio experiments, was directed against the earth's magnetic field to obtain very nearly a field free space. Horizontal fields in this working space were held to less than 0.01% of the earth's horizontal component. A.

538.083.9 : 621.317.41

6330. METHOD OF DETERMINING MAGNETIC PERMEABILITIES OF A SUBSTANCE IN THE REGION OF FERROMAGNETIC RESONANCE. A.I.Pil'shchikov.
Vestnik Moskov.Univ., No. 5, 49-54 (1956). In Russian.

Relationships are worked out which enable the magnetic susceptibility of a substance to be determined from experimental data in the region of ferromagnetic resonance. From these relations may also be determined the attenuation of a hollow resonator on account of losses in the ferromagnetic walls. A theoretical paper. C.R.S.Manders

538.113 : 539.11

6331. STUDY OF THE MAGNETISM OF AN ELECTRON GAS IN TWO DIMENSIONS. A.Marchand and A.Pacault.
Cahiers de Phys., No. 74, 37-8 (Oct., 1956). In French.

An exact solution for the diamagnetic susceptibility in terms of the number of carriers and their effective mass, is compared with experiments on graphite and carbon blacks (Abstr. 4732, 8433/1954), leading to values of these parameters. J.Hawgood

538.113

6332. ON THE TERM "CYCLOTRON RESONANCE".
Ya.G.Dorfman; V.N.Lazukin.
Uspekhi fiz. Nauk, Vol. 61, No. 1, 133-5 (1957). In Russian.

Dorfman deplores the substitution in Lazukin's paper (Abstr. 3570/1957) of the term "cyclotron resonance" for "diamagnetic resonance". Lazukin sums up the difficulties of the older term and the reasons for the new and suggests a third possibility "Dorfman–Dingle effect". C.R.S.Manders

538.113

6333. TEMPERATURE DEPENDENCE OF THE MAGNETIC SUSCEPTIBILITY OF THE ELECTRONS IN A METAL.
G.E.Zil'berman and F.I.Itskovich.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 158-60 (1957). In Russian.

Theoretical paper. Considers what happens in very weak magnetic fields where χ is practically independent of H. The contributions due, respectively, to small electron groups, a large electron group, a group of holes are worked out. It is pointed out how these contributions, with appropriate coefficients, when added can account for experimentally observed facts including even the curve with several maxima found by Verkin and Mikhallov (Abstr. 11209/1954) for Zn. C.R.S.Manders

538.114 : 548.7

6334. THE ISING MODEL AND FERRIMAGNETISM.
K.W.H.Stevens.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 537-9 (May, 1957).

An expression is found for the susceptibility of a body-centred cubic structure with ions of different g-values at the centre and corners of the unit cell, and with nearest-neighbour spins coupled by an Ising type interaction. It is shown that the susceptibility can be expressed as the sum of the susceptibilities of an antiferromagnetic and a ferromagnetic with different g-values. At high temperatures the susceptibility is similar to that of an antiferromagnetic but as the temperature is lowered the susceptibility becomes progressively more dependent on the ferromagnetic contribution.

A.E.De Barr
538.114

6335. CONTRIBUTION TO THE THEORY OF FERROMAGNETISM OF METALS AND ALLOYS AT LOW TEMPERATURES.
E.I.Kondorskiĭ and A.S.Pakhomov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 323-32 (1957). In Russian.

Formulae for the temperature dependence of spontaneous magnetization near absolute zero have been obtained for a ferromagnetic lattice consisting of one kind of atoms in the case when the number of electrons with uncompensated spins is larger than the number of atoms and for lattices of binary ordered alloys of various structure. The method of approximate secondary quantization was used in the calculations. It is shown that in all of the considered cases the theory leads to a temperature dependence of spontaneous magnetization which can be expressed by a "$T^{3/2}$ law". A.
538.22

6336. REINVESTIGATION OF REPORTED FERROMAGNETISM IN $Li_X Ni_{(1-x)} O$. T.P.Janusz, R.R.Heikes and W.D.Johnston.
J. chem. Phys., Vol. 26, No. 4, 973-4 (April, 1957).

The experiments of Perakis et al. (Abstr. 4491/1956) were repeated on a compound with x = 0.018. The susceptibility was measured between 190° and 480°K and no signs of ferromagnetism were detected.

E.P.Wohlfarth
538.22 : 537.312.62

6337. THE MAGNETIC PROPERTIES OF SOME SUPERCONDUCTING MERCURY COLLOIDS. C.S.Whitehead.
Proc. Roy. Soc. A, Vol. 238, 175-93 (Dec. 18, 1956).

Magnetization curves have been measured for fourteen colloidal mercury specimens whose average radius varied from 3×10^{-6} to 15×10^{-6} cm. For small applied fields the magnetic moments is proportional to the field and the observed temperature dependence of the slope is as predicted by the London theory. However, the dependence of these initial slopes on the average particle size cannot be explained by the London theory; the values found experimentally, extrapolated to 0°K, are numerically in better agreement with Pippard's modification of the London equation, but this does not correctly describe the temperature dependence. Measurements of the area of the magnetization curves give a mean value of -5 ± 12 A for the surface-energy parameter β, which means that the influence of this surface energy is negligible for most specimens. It was found that the magnetization curves of drops small compared with the penetration depth can be scaled to have the same shape at all temperatures. This property has been explained quantitatively by a suitable modification of the two-fluid model of the superconducting state, but the theory does not seem adequate to explain some of the hysteresis features in the magnetization curves of larger drops.

A.
538.221

6338. MAGNETIC PROPERTIES OF FINE PARTICLES.
E.P.Wohlfarth.
Sci. J. Roy. Coll. Sci., Vol. 26, 19-43 (1956).

A review of the following topics: magnetization of single-domain particles, permanent-magnet alloys, powder magnets (MnBi, Ferroxdure, iron), other applications (magnetic recording wires and tapes, rock magnetism, dilute ferromagnetic alloys), particle shape variations and interactions, thermal fluctuations, multidomain particles, other results (thermal changes and hysteresis loss, remanence curves, transverse susceptibility, rotational hysteresis), Morrish and Yu's experiment. 50 references.

E.P.Wohlfarth
538.221

6339. FERROMAGNETIC RESONANCE ABSORPTION BY THIN CONDUCTING FILMS IN CAVITIES. J.O.Artman.
J. appl. Phys., Vol. 28, No. 2, 277 (Feb., 1957).

Analysis of the energy absorbed in a ferromagnetic film deposited on a metal substratum, and on a dielectric substratum, in a cavity.

A.E.De Barr

538.221 : 541.67

6340. PERMANENT MAGNET OXIDES CONTAINING DIVALENT METAL IONS. I. L.G.Van Uitert, M.H.Read and F.J.Schnettler.
J. appl. Phys., Vol. 28, No. 2, 280-1 (Feb., 1957).

Some results of X-ray diffraction studies of compounds of the general composition $BaFe_{12}O_{19}.2M\,Fe_2O_4$, where M = Mg, Ca, Mn, Fe, Co, Ni, Cu, Zn or mixtures of these with Zn or Cu. A common pattern corresponding to the $BaFe_{18}O_{27}$ structure was found in some of the compounds, but $BaNi_2Fe_{16}O_{27}$ has a different structure from the others. When part of the Ni is replaced by Zn, however, the structure changes to that found for the others. Room temperature magnetic data on compositions of the series $BaCo_{2-X}Zn_XFe_{16}O_{27}$ show that replacing part of the Co in $BaCo_2Fe_{16}O_{27}$ with Zn increases the value of saturation induction up to approximately Zn = 0.8.

A.E.De Barr

538.221 : 541.6

6341. PERMANENT MAGNET OXIDES CONTAINING DIVALENT METAL IONS. II. L.G.Van Uitert and F.W.Swanekamp.
J. appl. Phys., Vol. 28, No. 4, 482-5 (April, 1957).

The dependence of saturation induction at room temperature upon composition for the substitution of nonmagnetic ions into $BaFe_{12}O_{19}$, into $BaM_2Fe_{16}O_{27}$ (where M_2 = Ni_2, $Ni_{1.5}Cu_{0.5}$, Zn_2), and into the mixture $BaNiFe_{14}O_{23}$ is given. Evidence is presented for the existence of points of magnetic compensation in a number of series wherein aluminium is substituted for iron. The distribution of that gallium takes in these structures appears to depend upon the sites occupied by divalent metal ions.

538.22

6342. THE PROCESS AND SIZE DISTRIBUTION OF BARKHAUSEN DISCONTINUITIES. K.Jost.
Z. Phys., Vol. 147, No. 5, 520-30 (1957). In German.

Reports results of measurements on Fe–Ni wires using an amplifier, discriminator and counter. The number of jumps in a given size range was measured as a function of field strength and a threshold-field effect was observed. The magnetization process are dependent on the specimen shape due to demagnetization.

E.P.Wohlfarth
538.221.0

6343. PERMEABILITY MEASUREMENTS IN THE CENTIMETRE WAVE REGION. L.Breitenhuber.
Acta phys. Austriaca, Vol. 11, No. 1, 88-100 (1957). In German.

The measurement of complex permeability of ferromagnetic materials by tuning and damping experiments using cavity resonators or Lecher wires is described and its importance in studies of relaxation and resonance phenomena is discussed. The perturbation theory equations of Ledinegg show that the results of these measurements are subject to certain errors but a null method is described which can avoid them. The wavelength changes to be expected in the case of the electrical fundamental oscillation of a cylindrical cavity resonator with an inner conductor are calculated. H.J.H.Stark

538.222/.22

6344. THE TEMPERATURE DEPENDENCE OF THE MAGNETIC SUSCEPTIBILITY OF ELEMENTS. B.I.Verkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 156-7 (1957). In Russian.

Normally substances are classified magnetically in terms of the sign of the experimentally measured susceptibility. A study of the variation of the susceptibility of elements with temperature in weak fields makes possible the division of the elements into four simple groups as follows: (a) elements with paramagnetism independent of temperature (e.g. alkali and alkali earth metals), (b) elements with paramagnetism dependent in temperature (e.g. rare earths and transition elements), (c) elements with diamagnetism increasing with fall of temperature (e.g. groups II, III, IV, V subgroups A), and (d) elements with diamagnetism independent of temperature (e.g. noble gases). The relation of these new groupings to the de Haas–van Alphen effect is discussed.

C.R.S.Mander

538.2

6345. MAGNETIC PROPERTIES OF NEODYMIUM SINGLE CRYSTALS. D.R.Behrendt, S.Legvold and F.H.Spedding.
Phys. Rev., Vol. 106, No. 4, 723-5 (May 15, 1957).

Magnetic measurements have been made on single crystals of neodymium which were grown by the Bridgman technique. At 20.4 and above, the susceptibility obtained with the field perpendicular to the c_0-axis of the hexagonal crystal is greater than that obtained with the field parallel to the c_0-axis. In this same temperature range anisotropy is observed in the basal plane. At 4.2°K antiferromagnetic ordering is indicated by the data and magnetic anisotropy in the basal plane is observed.

538.222

6346. THE MAGNETIC SUSCEPTIBILITY OF YTTERBIUM FROM 1.3°K TO 300°K. J.M.Lock.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 476-80 (May, 1957).

The susceptibility of ytterbium metal has been measured at room temperature and between 1.3°K and 80°K. Its magnitude seems to indicate that the atoms are mostly in the ^1S-state and the 4f-shell completely filled, only about 1 atom in 260 being in the $^2F_{7/2}$-state with 13 electrons in the 4f-shell. The paramagnetic saturation effect at the lowest temperatures seems to confirm this. The material has been tested for superconductivity down to 1.24°K in fields as low as 10 oersteds, with a negative result. A.

538.222

6347. PARAMAGNETIC RESONANCE AT RADIO FREQUENCIES IN LOW TEMPERATURE CARBONS. D.J.E.Ingram and J.G.Tapley.
Phil. Mag., Vol. 45, 1221-3 (Nov., 1954).

Confirmation of earlier experiments showing that two distinct types of paramagnetic resonance absorption occur in different types of carbon.

538.222

6348. PARAMAGNETIC RESONANCE IN ALKALI METALS. N.S.Garif'yanov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 149 (1957). In Russian.

The half-width, ΔH, of the electron resonance in lithium is shown to be sharply dependent on particle size falling from 20 Oe at 50 μ to 3 Oe at 0.1 μ; it is essentially independent of frequency from 9500 to 35 Mc/s and of temperature from 90 to 300°K. For Na of 0.1 μ size, ΔH = 110 Oe. D.H.Whiffen

538.222 : 536.48 : 536.631

MAGNETIC PROPERTIES OF FERRIC METHYLAMMONIUM SULPHATE. See Abstr. 6135

538.224

6349. MAGNETIC ANISOTROPY OF BENZENE. J.Hoarau, J.Joussot-Dubien, B.Lemanceau, N.Lumbroso and A.Pacault.
Cahiers de Phys., No. 74, 34-7 (Oct., 1956). In French.

See Abstr. 5249 (1956). K_1, K_2 and K_3 are combined to give $\Delta K = -59.7 \times 10^{-6}$. J.Hawgood

538.245 : 538.65 : 539.434

6350. PLASTIC BEHAVIOUR OF MAGNETIZED NICKEL CRYSTALS. H.Blank.
Naturwissenschaften, Vol. 43, No. 21, 494 (1956). In German.

Describes results of creep experiments on nickel in the presence of a magnetic field, the strains induced by continuous or sudden changes of the field strength being measured.

E.P.Wohlfarth

538.245

6351. SPONTANEOUS MAGNETIZATION AND MAGNETIC SUSCEPTIBILITIES OF AN ANTIFERROMAGNETIC WITH FOREIGN IONS IN BOTH SUBLATTICES. K.F.Niessen.
Philips Res. Rep., Vol. 12, No. 1, 69-81 (Feb., 1957).

The spontaneous magnetization is calculated as a function of the temperature for an antiferromagnetic, in the two sublattices of which a different but relatively small number of original ions are assumed to be replaced by ions of another metal, carrying another magnetic moment. For a real calculation, the Néel temperature of the material must be measured and also the Néel temperature of the original antiferromagnetic (in which the above replacement has not yet taken place). From the ingredients used for the preparation of the material the sum of the foreign ions in the two sublattices will be known, but not their ratio. This ratio, however, can be derived as a function of the temperature from the spontaneous magnetization. The change in the parallel and perpendicular susceptibilities, due to the above replacement of original by foreign ions is also determined. A.

538.245

6352. CRITICAL SIZE AND NUCLEATION FIELD OF IDEAL FERROMAGNETIC PARTICLES.
E.H.Frei, S.Shtrikman and D.Treves.
Phys. Rev., Vol. 106, No. 3, 446-55 (May 1, 1957).

The field at which the spins of a previously saturated ideal ferromagnetic particle cease to be aligned is defined as the nucleation field. This field is calculated, using calculus of variation, for an infinite cylinder and a sphere, assuming three mechanisms of magnetization reversal: spin rotation in unison, magnetization curling, and magnetization buckling. Theoretical treatment shows that, in fact, only curling and rotation in unison need be considered. The critical size for single-domain behaviour, defined as the largest size at which magnetization reversal proceeds by rotation in unison, is calculated for the prolate ellipsoid and is found to be practically independent of magnetocrystalline anisotropy and elongation and approximately equal to $A^{1/2}/I_S$. Here A is the exchange constant and I_S is the saturation magnetization. For cylinders larger than the critical size, the coercive force, for a field applied in the direction of the long axis, is found to be equal to the nucleation field, when magnetocrystalline anisotropy is neglected. The coercive force thus calculated decreases with the radius of the cylinder, R, according to $H_C = 6.78A/I_SR^2$. Available experimental data are discussed and are generally found to be in a better agreement with this than with previous theory. A.

538.245

6353. DOMAIN PATTERNS ON FERRITE SINGLE CRYSTALS. R.F.Pearson.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 441 (April, 1957).

Domain patterns, obtained by the magnetic colloid technique, are reproduced as photographed on cleaved basal planes of the ferrimagnetic compounds $BaFe_{12}O_{19}$ and $Ba_3Zn_2Fe_{24}O_{41}$. The patterns are interpreted on the lines proposed by Goodenough for materials with high uniaxial anisotropy (Abstr. 4517/1956). F.F.Roberts

538.247

6354. INVESTIGATION OF THE DEMAGNETIZATION PROCESS IN ALNICO OF HIGH COERCIVE FORCE WITH THE HELP OF POWDER PATTERN TECHNIQUE. W.Andrä.
Ann. Phys. (Leipzig), Vol. 19, No. 1-2, 10-18 (1956). In German.

An extension of previous work (Abstr. 6014/1956) on anisotropic Alnico. A series of powder photographs parallel and perpendicular to the preferred direction show the growth of anti-parallel domains during demagnetization. A.E.De Barr

538.249 : 538.652

6355. TEMPERATURE VARIATION OF THE MAGNETOSTRICTION OF FERROMAGNETIC ALLOYS. D.I.Volkov, V.I.Chechernikov and V.B.Tseĭtlin.
Vestnik Moscov. Univ., No. 2, 21-8 (1956). In Russian.

The temperature dependence was investigated for alloys Ni–Cu, Ni–Mn, Ni–Co, 45%Ni–55%Fe at temperatures near the Curie point. The linear law for change of magnetostriction saturation with temperature, given by theory, accounts satisfactorily for the results observed. Ni–Co alloys exhibit allotropy and jumps of magnetostriction are observed at the temperature of modification as well as a considerable hysteresis on the $\lambda_S(T)$ curves. C.R.S.Manders

538.27 : 538.652

6356. THE THEORY OF THE MAGNETOSTRICTION OF NICKEL SINGLE CRYSTALS. U.F.Braun (W.F.Brown), Jr.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 5, 827 (1957). In Russian.

In recent experiments Akulov (Abstr. 4503/1956) finds for change of elongation in Ni crystals during magnetization along [111] his own curves gave better agreement with experiment than those calculated by Gans and Harlem (Ann. Phys. (Leipzig), Vol. 15, 516, 1932; Vol. 16, 162, 1933) based on Heisenberg's work (Z. Phys., Vol. 69, 287, 1931). The author draws attention to his own paper (Phys. Rev., Vol. 52, 325, 1937) in which it is shown that such divergence is the result of error in Gans and Harlem's calculations. Curves calculated correctly on the basis of Heisenberg theory coincide satisfactorily with experimental data. C.R.S.Manders

538.27 : 538.652

6357. APROPOS OF THE NOTE BY W.F.BROWN, "THE THEORY OF MAGNETOSTRICTION OF NICKEL SINGLE CRYSTALS". N.S.Akulov.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 5, 828-30 (1957). In Russian.

The error in Gans and Harlem pointed out by Brown (see preceding abstract) is of no significance in Akulov's theory and calculations, and the objection against the formal method, used by Heisenberg, remains even with Brown's corrections. Akulov concludes that coincidence of his own results with those of experiment is difficult to account for by experimental error. C.R.S.Manders

538.27 : 538.652

6358. MAGNETOSTRICTION AND MAGNETIC ANISOTROPY OF MnBi. H.J.Williams, R.C.Sherwood and O.L.Boothby.
J. appl. Phys., Vol. 28, No. 4, 445-7 (April, 1957).

The magnetostriction of oriented polycrystalline MnBi was found to be higher than any published value for a metal. A value of -250×10^{-6} was measured parallel to a field of 22 000 Oe oriented perpendicular to the c axis of the aligned hexagonal crystallites. This field magnetized the specimen to only slightly more than half of saturation. A tentative value of -800×10^{-6} for the magnetostriction at saturation was obtained by plotting the magnetostriction

as a function of $(B-H)^2$ and extrapolating to saturation. Magnetic anisotropy constants of $K_1 = 9.1 \times 10^6$ ergs per cm^3 and $K_2 = 2.6 \times 10^6$ ergs per cm^3 were obtained by fitting a calculated curve to the experimental magnetization curve. A.

ELECTROMAGNETISM. ELECTRODYNAMICS

538.3/.5

538.3.081

6359. DIMENSIONS AND UNITS IN ELECTROMAGNETISM. G.L.Trigg.
Amer. J. Phys., Vol. 25, No. 2, 117 (Feb., 1957).

The quantity α, defined in the relation for the force acting on a current element $d\vec{F} = \alpha^{-1} Id\vec{l} \times \vec{B}$ and defining the units of induction, may not be equal to unity in all systems of units. E.P.Wohlfarth

538.3

6360. THE CLASSICAL ELECTROMAGNETIC EQUATIONS EXPRESSED AS COMPLEX FOUR-DIMENSIONAL QUANTITIES. E.F.Bolinder.
J. Franklin Inst., Vol. 263, No. 3, 213-23 (March, 1957).

It is possible to compress the classical electromagnetic equations into three complex, four-dimensional quantities Ω', $^4\bar{\Gamma}'$, and $^4\bar{\Psi}'$. These quantities represent electromagnetic fields, currents and charges, and vector and scalar potentials. In addition to the four-dimensional quantities, a complex vector $\bar{Q}' = a\bar{E} + jb\bar{B}$ is introduced, where $\bar{E}$ = electric field strength, $\bar{B}$ = magnetic induction, $j = \sqrt{-1}$, and a and b are real or pure imaginary constants. The components of $\bar{Q}'$ represent two related modes, one electric and one magnetic. A.

538.3 : 531.01 : 530.145

LAGRANGIAN FORMULATION AND MECHANICAL INTERPRETATION. See Abstr. 5876

538.3 : 532.5 : 536.252

EXPERIMENTS ON THE INHIBITION OF THERMAL CONVECTION BY A MAGNETIC FIELD. See Abstr. 6103

538.31 : 550.38

6361. ELECTROMAGNETIC INDUCTION IN ROTATING CONDUCTORS. A.Herzenberg and F.J.Lowes.
Phil. Trans A, Vol. 249, No. 970, 507-84 (1957).

This paper describes an experimental and theoretical investigation of induction in a rotating conductor surrounded by a rigid conductor of finite or infinite extent. The results are applied to a discussion of induction in rotating eddies in the fluid core of the earth as a possible origin of the geomagnetic non-dipole field. Model experiments were made with rigid rotators in a steady magnetic field; the induced magnetic field was measured outside the conductors. The results confirmed the appropriate parts of the theoretical work. In the theoretical work solutions are first obtained for a rotator embedded in a solid conductor of infinite extent; a method is then developed for extending this solution to a finite surrounding conductor. Charts are given for the induced field on the surface of the earth due to a hypothetical rotator in the earth's core. The analysis is based on integral solutions of the field equations; wherever possible the field vectors themselves are used rather than a vector potential. The induced magnetic fields depend on the relative symmetry of the rotator, the surrounding conductor, and the applied magnetic field. For an applied field parallel to the axis of rotation, the induced field is proportional to the angular velocity; for an applied field perpendicular to the axis, the induced field reaches a limit at high angular velocities. If both the surrounding conductor and the applied magnetic field have rotational symmetry about the axis there is no induced field outside the surrounding conductor. The conclusion of the geophysical discussion is that eddies must have radii of several hundred kilometres if they are to account for the observed magnitude of the non-dipole field. Because of the skin effect such large radii would not be tenable if the core material were effectively rigid. However, fluid motions must occur due to the electromagnetic forces, and the consequent magneto-hydrodynamic disturbances probably have decay lengths much larger than the rigid conductor skin depth; therefore arguments based on the rigid conductor skin depth are not applicable. Thus the eddy model might be satisfactory if the fluid motion does not seriously alter the basic induction mechanism. A.

538.52

6362. NOTE ON PRODUCTION OF STRONG MAGNETIC FIELDS OF SHORT DURATION AND MEASUREMENT OF THEIR INTENSITY. A.Piekara, J.Małecki, M.Surma and J.Gibalewicz.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 432-4 (April, 1957).

A note on the use of a five-layer coil of 154 turns to produce a magnetic field of peak intensity 350 000 oersteds in a volume of 1 cm The field was measured by recording the voltage from a search coil and also by a method based on the Faraday magneto-optical effect. A.E.De Barr

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.561 : 621.375

6363. PROPOSAL FOR A FERROMAGNETIC AMPLIFIER IN THE MICROWAVE RANGE. H.Suhl.
Phys. Rev., Vol. 106, No. 2, 384 (April 15, 1957).

A proposal for utilizing as an amplifier a system in which two ferromagnetic modes are coupled to a time varying load (the uniform precession). Arrangements are described in which (1) the sample serves both as doubly resonant system and coupling element (magnetostatic), (2) the sample is placed in a cavity so that the two functions are separated (electromagnetic), and (3) the cavity supplies one mode and the sample the other (semi-static). The device should have a low noise level. A.E.De Bar

538.56

6364. ON RADIATION IN ANISOTROPIC MEDIA. F.V.Bunkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 338-46 (1957). In Russian.

A general solution is given for the problem of a field produced by a given distribution of currents in an infinite homogeneous medium possessing arbitrary anisotropy (including gyrotropic media). In the particular case of a magnetoactive medium described by a certain tensor the radiation field has been expanded into multipoles. In conclusion, the radiation of a dipole in a magnetoactive medium is considered in detail. A

538.56

6365. EXTENSION OF BABINET'S PRINCIPLE TO ABSORBING AND TRANSPARENT MATERIALS, AND APPROXIMATE THEORY OF BACKSCATTERING BY PLANE, ABSORBING DISKS. H.E.J.Neugebauer.
J. appl. Phys., Vol. 28, No. 3, 302-7 (March, 1957).

A rigorous formulation of Babinet's Principle has been found by Copson and by Meixner for perfect conductors. A recently published theory of diffraction by holes in absorbing and transparent screens suggests a generalization of Babinet's Principle to absorbing and transparent materials. The generalized form of Babinet's Principle is not a rigorous statement; it holds only for certain approximate solutions. In this paper it is used to calculate backscattering by circular disks of various reflection coefficients from zero to unity. Experimental results by Severin and v.Baeckmann support the theory. It is expected that, in a succeeding paper, it can be shown that scattering by solid bodies may be calculated in a similar way if the bodies are bounded by plane surfaces large compared to wavelength. A

538.566 : 621.396.11

6366. FUNDAMENTAL RADIO SCATTER PROPAGATION THEORY. E.C.S.Megaw.
Proc. Instn Elect. Engrs, Monogr. 236R, publ. May, 1957, 15 pp. To be republished in Part C.

Presents a detailed theoretical treatment of the beyond-horizon radio scatter propagation problem. The form for the spectral density of refractive-index fluctuation, assumed to be the same as that of velocity fluctuation, is derived from the universal equilibrium theory of turbulence. It is used to predict the spectral density and magnitudes of brightness fluctuation and angular deflection fluctuation for light from a stellar source, and of field-strength fluctuation for line-of-sight radio propagation. These predictions are compared with experimental data, and support is thereby obtained for the theoretical form of the refractive-index fluctuation spectrum. The height variation of the intensity of the refractive-index fluctuations is derived from the experimental data. There follows a detailed treatment of the beyond-horizon case of radio scatter propagation, including a full analysis of the influence of the geometry of

the scattering volume on the received field-strength. It is shown that the form of the scattering cross-section implied in the results is compatible with those obtained in different treatments, based on idealized assumptions. A.

538.566.2 : 621.318.12 : 621.372.852.22

6367. A SURVEY OF THE THEORY AND APPLICATIONS OF FERRITES AT MICROWAVE FREQUENCIES.
P.J.B.Clarricoats, A.G.Hayes and A.F.Harvey.
Proc. Instn Elect. Engrs, Paper 2229R, publ. Oct., 1956 (Part B Suppl. No. 6, 267-82, 283-5).

Republication, with discussion, of the paper abstracted in Abstr. 562 (1957).

538.566.2

6368. THE INTRODUCTION OF A "SPACE WAVELENGTH" IN SOME PROBLEMS OF RADIO PROPAGATION. F.du Castel.
Rev. Opt., Vol. 35, No. 12, 657-66 (Dec., 1956). In French.

It is shown that certain aspects of the theory of radio propagation may be investigated by the use of an equivalent Bragg relation for optical diffraction. Details are given of the theoretical results obtained by the introduction of a "space wavelength", related to the wavelength used and the angle of deviation, to the problems of guided propagation in an atmospheric duct and tropospheric scattering in the atmosphere. G.M.Brown

538.567.3 : 621.375 : 621.373

6369. QUANTUM MECHANICAL AMPLIFIERS.
M.W.P.Strandberg.
Proc. Inst. Radio Engrs, Vol. 45, No. 1, 92-3 (Jan., 1957).

A discussion of the advantages and possibilities of electron resonance or nuclear resonance maser oscillators and amplifiers. In principle these could be tunable and the amplifiers approach a noise figure of unity for any source temperature. D.H.Whiffen

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

6370. CRYSTAL DYNAMICS. H.Jones.
Nature (London), Vol. 179, 451-3 (March 2, 1957).

Report of a Physical Society conference held at Queen Mary College, London, in January 1957. The conference was divided into four sessions, each opened by a lecture reviewing the subject of the session which was followed by shorter and more specialized contributions. The following papers are mentioned:
Session 1: M.Blackman (review of types of vibrational spectra of crystals and of heat capacity curves); M.H.L.Pryce (a new form of lattice statics); C.Domb (calculation of anharmonic properties); E.R.Dobbs (solid argon); D.Bijl (analysis of specific heat data).
Session 2: G.L.Squires (review of determination of vibration frequencies by means of X-ray and neutron scattering); K.Lonsdale (anisotropic vibrations in crystals); D.H.Martin (infrared spectroscopy); G.V.Chester (inelastic neutron scattering in crystals).
Session 3: J.M.Ziman and R.Berman (review of thermal conductivity of non-metals); H.M.Rosenberg (thermal conductivity of zinc and cadmium); J.Wilks (thermal boundary resistance between metals and liquid helium II); R.Fürth (fluctuations of stress and strain in crystals); E.H.Sondheimer (thermal conductivity of metals in strong magnetic fields). Session 4: H.Brooks (review of the theory of electron–phonon interaction in metals); G.O.Jones (superconductivity at high pressures); P.G.Klemens (conductivity of metals at low temperatures); A.B.Pippard (ultrasonic attenuation in metals).
No detailed proceedings of the conference will be published. E.H.Sondheimer

539.11

6371. A DESCRIPTIVE INTERPRETATION OF THE APPEARANCE OF ENERGY BANDS IN A PERIODIC POTENTIAL FIELD.
T.Sexl and E.Spurny.
Acta phys. Austriaca, Vol. 10, No. 3, 287-91 (1956). In German.

It is shown that when two disconnected (square, linear) potential wells are brought together from infinite separation, their energy levels split into doublets. Qualitative extension to more than two wells leads to the concept of energy bands. R.Stratton

539.11

6372. CORRELATION ENERGY OF AN ELECTRON GAS AT HIGH DENSITY. M.Gell-Mann and K.A.Brueckner.
Phys. Rev., Vol. 106, No. 2, 364-8 (April 15, 1957).

The quantity ϵ_c is defined as the correlation energy per particle of an electron gas expressed in Rydbergs. It is a function of the conventional dimensionless parameter r_s, where r_s^{-3} is proportional to the electron density. Here ϵ_c is computed for small values of r_s (high density) and found to be given by $\epsilon_c = A \ln r_s + C + O(r_s)$. The value of A is found to be 0.0622, a result that could be deduced from previous work of Wigner (1934), Macke (Abstr. 7025/1950) and Pines (Abstr. 1279/1954, 6038/1956). An exact formula for the constant C is given here for the first time; earlier workers had made only approximate calculations of C. Further, it is shown how the next correction in r_s can be computed. The method is based on summing the most highly divergent terms of the perturbation series under the integral sign to give a convergent result. The summation is performed by a technique similar to Feynman's methods in field theory. A.

539.11

6373. SPECIFIC HEAT OF A DEGENERATE ELECTRON GAS AT HIGH DENSITY. M.Gell-Mann.
Phys. Rev., Vol. 106, No. 2, 369-72 (April 15, 1957).

The methods of the preceding abstract are generalized so that not only the ground state but also the low excited states of an electron gas can be discussed. The energy levels relative to the ground state are the same as those of a gas of independent particles where the energy of each particle (in Rydbergs) is a certain function W(p) of its momentum (expressed in units of the Fermi momentum). The specific heat of the gas at low temperature is proportional to the density of single particle levels at the surface of the Fermi sea, or inversely proportional to $(dW/dp)_{p=1}$. This last quantity is calculated for high density (small r_s, where density is proportional to r_s^{-3}) and compared to the corresponding quantity for a free electron gas. The ratio is found to be $1 + 0.083 r_s[-\ln r_s - 0.203] +$ higher terms in r_s. The expansion is exact and may be compared with the approximate result of Pines (Abstr. 6038/1956) who finds $1 + 0.083\ r_s\ [-\ln r_s + 1.47] + \ldots$. A.

539.11

6374. CORRELATION ENERGY OF AN ELECTRON GAS AT HIGH DENSITY. K.Sawada.
Phys. Rev., Vol. 106, No. 2, 372-83 (April 15, 1957).

The correlation energy of an electron gas at high density is evaluated up to terms of orders $(r_s)^0$ and $\log r_s$. It is shown that the correlation energy to this order can be evaluated without using perturbation treatment. The result obtained coincides with the result of formal summation of apparently divergent series arising from small momentum transfer processes which has been discussed fully by Gell-Mann and Brueckner (two preceding abstracts). The method to treat the small momentum transfer effect exactly is given by following the analogy of processes with well-known treatment of systems with Hamiltonians which are bilinear in creation and annihilation operators such as the neutral scalar pair theory. Some simple interpretations of the correlation energy to this order are also given. A.

539.11

6375. ENERGY BANDS IN GALLIUM ARSENIDE.
J.Callaway.
J. Electronics, Vol. 2, No. 4, 330-40 (Jan., 1957).

The energy band structure of GaAs is investigated by means of second-order perturbation theory applied to the known band structure of Ge. It is found that there is a tendency for the valence band to move to lower energies in comparison with Ge while the levels at the bottom of the conduction band are relatively stationary. A shift of the conduction band minimum from the centre of a hexagonal face of the Brillouin zone to the centre is likely. A larger optical energy gap is also expected. C.A.Hogarth

539.11 : 536.48

ENERGY SPECTRUM OF SOLID HELIUM. See Abstr. 6116

MOLECULES 539.13

539.13

6376. APPLICATION OF THE THEORY OF KIRKWOOD–BAUER–MAGAT TO THE DETECTION OF MOLECULAR ASSOCIATIONS.
J.Lascombe, G.Sourisseau, P.Saumagne, C.Castinel, P.Dizabo, J.P.Leicknam and M.L.Josien.

Cahiers de Phys., No. 73, 44-6 (Sept., 1956). In French.

The K.B.M. relationship on the effects of solvents as determined by infrared spectroscopy,

$$\frac{\nu_{gas} - \nu_{solution}}{\nu_{gas}} = C\frac{n^2 - 1}{2n^2 + 1},$$

has been used to investigate the molecular association of phenol in solution in various solvents, using the νOH fundamental. The variation of the constant C with the nature of the vibrating group is graphically represented. G.I.W.Llewelyn

539.13

6377. SCATTERING OF LOW VELOCITY MOLECULAR BEAMS IN GASES. E.A.Mason.

J. chem. Phys., Vol. 26, No. 3, 667-77 (March, 1957).

A large number of partial and total molecular scattering cross-sections have been calculated numerically for molecules obeying an exp-six potential, consisting of an exponential repulsion term and an inverse sixth-power attraction term. The tabulations cover a wide range of scattering angles, energies, and potential parameters, and can be used to obtain information about intermolecular forces from the results of experiments on the scattering of low velocity molecular beams in gases. The calculations are classical throughout, and quantum effects are ignored, but an approximate formula is given for estimating where the classical calculations break down in any particular case. The use of the tables is illustrated by a comparison with Knauer's results on the scattering of beams of H_2 in mercury vapour. A.

539.13

6378. THE INFLUENCE OF ELECTRONIC AND MOLECULAR CONCENTRATION ON THE APPARENT PROBABILITY OF THE TRANSITION $A^3\Sigma_u - X^1\Sigma_g$ OF THE NITROGEN MOLECULE.

H.Schram, R.W.Lunt and L.Herman.

J. Phys. Radium, Vol. 18, No. 1, 59-67 (Jan., 1957). In French.

Describes experimental study of the variation with electron concentration of the intensity ratio of the transitions $A^3\Sigma_u - X^1\Sigma_g$ and $C^3\Pi_u - B^3\Pi_g$ in pure N_2 and in a mixture of N_2 and Xe (see Abstr. 3633/1956). The results are interpreted in terms of the various possible excitation and deactivation processes, and it is shown that collisions with electrons and with $N_2(X)$ molecules are both important in the deactivation of $N_2(A)$ molecules. J.Hawgood

539.132

6379. MOLECULAR QUANTUM MECHANICS CONFERENCE.

Texas J. Sci., Vol. 8, No. 2, 135-92 (June, 1956).

Report of a conference sponsored by the National Science Foundation (U.S.A.) and held at the University of Texas in December 1955. Contains summaries only of the 36 papers presented, details of which are as follows: Electronic structure of some simple diatomic molecules, M.Kotani (135-6); Electronic structure of ozone, I.Fischer-Hjalmars (136-8); Electronic structure of BH, R.C.Sahni (139-41); Short range intermolecular forces, E.A.Mason and J.O.Hirschfelder (142); On the validity of the assumption of two-body interactions in molecular physics, L.Jansen and R.T.McGinnies (143-4); Present status of molecular computation, M.P.Barnett (145-6); Digital computer programs for the calculation of electronic wave functions, R.K.Nesbet (147); Evaluation of molecular integrals by electronic digital computers (title only), C.C.J.Roothaan and C.W.Scherr (147); Gaussian atomic and molecular eigenfunctions, C.R.Mueller and J.M.Cahill (147-9); Interactions between closed electron shells, K.S.Pitzer and W.E.Donath (150-1); On the pi-electron approximation and its possible refinement, P.G.Lykos and R.G.Parr (152); The electronic spectrum and structure of azulene, R.Pariser (153-4); Simplified self-consistent molecular orbital methods and applications to hydrocarbons, J.A.Pople (154); The density matrix in self-consistent field theory, R.McWeeny (155-6); Interaction between vibrational and electronic motion in molecules, D.S.McClure (156-7); Interpretation of the lowest frequency electronic absorption bands of inorganic molecules of type $XO_y^{z(-)}$ as $\rightarrow \pi^*$ transitions, S.P.McGlynn and M.Kasha (158-61); Vacancy colour centres in diamond with reference to the Goeppert-Mayer-Sklar approximation, C.A.Coulson (161-2); Electronic correlation in the theory of molecular energy levels, P.O.Löwdin (163-4); Topics in the theory of optical rotation, W.Moffitt (164-5); Electronic structure, chemical reactivity and carcinogenic activity of aromatic molecules, B.Pullman (166-8); The standard excited state theory and its application to large polycyclic molecules, G.G.Hall (168-9); The localizability of electrons and the general theory of chemical bonds, S.Besnainou, H.Brion, R.Daudel, S.Odiot and M.Roux (170-1); Theoretical basis for the experimental determination of odd-electron densities in aromatic free radicals using paramagnetic resonance, H.M.McConnell (171-3); A two-dimensional modification of the electron gas method. The postulatory nature of the one-dimensional model, H.Kuhn (174-5); Resonance force theory of carotenoid pigments, W.T.Simpson (175); Steric inhibition of hyperconjugation, H.H.Jaffé (175-6); The electronic energy levels of composite systems, H.C.Longuet-Higgins (176-7); Wavelength formulas and configuration interaction in Brooker dyes and chain molecules, J.R.Platt (178); Machine computation of molecular integrals encountered on one-center expansions, T.C.Chen and H.Sponer (179-82); Delta potential function model for electronic energies in molecules, A.A.Frost (182-4); The application of LCAO-molecular orbital theory to some diatomic systems, V.Griffing (184-6); Spinless bond eigenfunctions, F.A.Matsen (186-8); Inclusion of electronic interaction in the free-electron theory and application to the spectra of aromatic hydrocarbons, N.S.Ham and K.Ruedenberg (189); A progress report on some accurate calculations on some simple molecules, J.E.Kilpatrick (189-90); Single-center wave function expansion for H_2, H.Shull and S.Hagstrom (190-1); Calculations of S.C.F. L.C.A.O. M.O.'s by successive applications of perturbation procedures, R.Lefebvre and C.M.Moser (192).

539.132 : 535.34

ROTATION-INVERSION TRANSITIONS IN ND_3. See Abstr. 600

539.132 : 539.13

6380. A PERTURBATION CALCULATION OF PROPERTIES OF THE 1sσ AND 2pσ STATES OF HeH^{2+}. A.Dalgarno and A.L.Stewart

Proc. Roy. Soc. A, Vol. 238, 276-85 (Dec. 18, 1956).

A perturbation calculation, valid in the limit of large separation, of various properties of the 1sσ and 2pσ states of HeH^{2+} is carried out. The total energy and the kinetic and potential energies are calculated to the fifth order, the dipole moments to the third order and the quadrupole moments to the second order. The results are compared with those obtained using exact and variationally determined two-centre wave-functions and also with those obtained from an approximate application of perturbation theory and it is shown that perturbation calculations of molecular properties are capable of high accuracy over a wide range of nuclear separations. A

539.13

6381. CONTRIBUTION TO THE STUDY OF THE VIBRATIONS OF THE BENZENE NUCLEUS IN THE REGION 1400-1600 cm^{-1}: MONOSUBSTITUTED AND PARADISUBSTITUTED DERIVATIVES.

J.M.Lebas, C.Garrigou-Lagrange and M.L.Josien.

Cahiers de Phys., No. 73, 31-6 (Sept., 1956). In French.

The observed infrared and Raman frequencies of C_6H_5X (where X = D, NO_2, SH, Cl, Br, CF_3, COCl, CHO, CN, CCl_3, SO_2Cl, $COOC_2$, I, F, OH, NH_2, $CHCl_2$, OCH_3, CH_2Cl, CH_3, C_6H_5N) in 0.5 M solution in CCl_4 and, where applicable, in the liquid state, are tabulated for the range 1400-1630 cm^{-1} and briefly interpreted. The Raman frequencies near to 1600 cm^{-1} for the p-disubstituted derivatives, containing generally the same substituted groups, are also given. The mass of the substituted groups, as well as their electronic effects influences the frequencies exhibited by the benzene nucleus. G.I.W.Llewelyn

539.13

6382. ROTATION ISOMERISM OF SUBSTITUTED ACETIC ESTERS ELUCIDATED BY INFRARED SPECTROSCOPY.

C.Castinel, R.Calas and M.L.Josien.

Cahiers de Phys., No. 73, 46-8 (Sept., 1956). In French.

The C=O valency vibration has been studied for series of allyl, methyl, and ethyl acetic esters. In each series, the acetates and trichloroacetates show only one band, but two valency bands are recorded for the mono- and di-halogenoacetates, coinciding with the absence of ternary symmetry in the terminal group. G.I.W.Llewelyn

539.13

6383. INTERACTIONS OF VIBRATIONAL AND ROTATIONAL RESONANCE. G.Amat.

Cahiers de Phys., No. 77, 25-39 (Jan., 1957). In French.

Theoretical methods are proposed for the calculation of the vibration–rotation energy of a molecule and for the determination of the perturbations, quasi-degeneration, and resonance. The interactions which affect the vibration–rotation energy are discussed and the theoretical relationships deduced are verified for the CO_2 molecule. G.I.W.Llewell

539.1

6384. THE INVERSE KINETIC ENERGY MATRIX ELEMENTS FOR THE OUT-OF-PLANE VIBRATIONS IN FURAN THIOPHENE CYCLOPENTADIENE AND THEIR SUBSTITUTED COMPOUNDS.

V.Santhamma.

Indian J. Phys., Vol. 30, No. 9, 429-49 (Sept., 1956).

The inverse kinetic energy matrix elements for the torsional vibrations, out-of-plane bending vibrations and the interaction between the above two are derived for furan, pyrrole, thiophene, and cyclopentadiene using the vector expressions given by Malhiot and Ferigle (Abstr. 2937/1955). The applicability of these expressions to the substituted compounds of the above parent molecules and the limitations imposed are discussed. A.

539.132

6385. RATE PROCESSES AND NUCLEAR MAGNETIC RESONANCE SPECTRA. II. HINDERED INTERNAL ROTATION OF AMIDES. H.S.Gutowsky and C.H.Holm.
J. chem. Phys., Vol. 25, No. 6, 1228-34 (Dec., 1956).

Mathematical methods are presented for calculating rate constants of processes which have narrow nuclear magnetic resonance absorption lines having discrete components. High resolution proton spectra show that the $R_1CO\text{-}NR_2R_3$ skeletons of N,N-dimethylformamide (DMF) and N,N-dimethylacetamide (DMA) are planar and suggest that N-methylformamide, N-methylacetamide, N-methylformanilide and N-methylacetanilide exist predominantly in one configuration. The presence of a significant amount of double bond character in the C–N amide bond is proved by the temperature dependent coalescence observed for the chemically shifted proton doublet of the $N(CH_3)_2$ groups in DMF and DMA, which gives values of about 22 and 19 kcal respectively for the free energy of activation required for reorientations about the bond. A.

539.132

6386. ASSIGNMENT OF THE OH BENDING FREQUENCY IN ALCOHOLS. P.Tarte and R.Deponthière.
J. chem. Phys., Vol. 26, No. 4, 962-3 (April, 1957).

A systematic study has been made of the infrared spectra of ordinary and deuterated alcohols in the gaseous state. In ethyl alcohol two bands (1243, 1030 cm^{-1}) are shifted by deuteration to 890 790 cm^{-1}, while in secondary and tertiary alcohols two bands disappear on deuteration but only one band appears in the deuterated compound. Results are compared with previous work (Abstr. 4551/1956). R.C.Seymour

539.132 : 541.62

6387. C–Cl STRETCHING FREQUENCIES IN RELATION TO ROTATIONAL ISOMERISM. S.Mizushima, T.Shimanouchi, K.Nakamura, M.Hayashi and S.Tsuchiya.
J. chem. Phys., Vol. 26, No. 4, 970-1 (April, 1957).

C–Cl stretching frequencies have been assigned for the mono- and di-chloro derivatives of certain hydrocarbons and their rotational isomers, and it is shown that the frequencies depend upon the configuration of the isomers. R.C.Seymour

539.132 : 535.343

6388. CONTRIBUTION TO THE STUDY OF VIBRATION–ROTATION SPECTRUM OF NITROUS OXIDE. M.L.Grenier-Besson.
Cahiers de Phys., No. 69, 8-48 (May, 1956). In French.

For previous work see Abstr. 8893 (1956). After a theoretical discussion follows a description of the experiment, carried out from 4.5 to 1.5 μ with an absorption path of 140 m and near 300°C. Some 60 bands were observed including about 20 new weak ones, corresponding to transitions to higher quantum numbers. Hence it was possible to calculate the vibrational constants taking first order anharmonic resonance interaction into account. While the computed vibrational levels are in good agreement with experimental values it is suggested that it will henceforth be necessary to take account of yet higher order corrections. J.Jacobs

539.132

6389. VIBRATION–ROTATION BANDS OF ACETYLENE AND THE MOLECULAR DIMENSIONS. M.T.Christensen, D.R.Eaton, B.A.Green and H.W.Thompson.
Proc. Roy. Soc. A, Vol. 238, 15-30 (Dec. 4, 1956).

In view of recent inconsistencies in the relation between the bond lengths and rotational constants in the isotopic acetylenes, some vibration-rotation bands of acetylene have been re-measured, and the results have been analysed together with earlier work on this molecule. The α-values for each of the molecular vibrations have been re-determined, taking into account possible vibrational perturbations and also anomalous changes in the centrifugal stretching constant D of the different vibrational levels. The new values of α_1, α_2, α_3 and $(\alpha_4 + \alpha_5)$ for acetylene are in line with the corresponding values for the deuterated derivatives, and using $B_0 = 1.1766$ lead to $B_e = 1.1817$. If bond lengths $r_e(CH) = 1.058_5$, $r_e(CC) = 1.204_7$ A are assumed, the results for all three isotopic molecules are mutually consistent. Values have also been obtained for the l-doubling coefficients, q_4 and q_5. A.

539.132

6390. CALCULATION OF THE GROUND STATE OF THE HYDROGEN MOLECULE ON THE BASIS OF THE VARIATION METHOD. F.Berencz.
Acta phys. Hungar, Vol. 6, No. 3-4, 423-41 (1957). In German.

The binding energy of the H_2 molecule in the ground state has been calculated by means of the variational method using the Hund–Mulliken wave-function and employing one-electron wave-functions in elliptical coordinates with the introduction of two new variation parameters. The dissociation energy was found to be 3.60 eV by this method. The wave-function may be improved by taking account of electron interaction with the introduction of a third variation parameter when the result is D = 4.26 eV, R = 0.76 A. Interest in this new method lies in the fact that it yields a value only 0.46 eV below that of James and Coolidge (J. chem. Phys., Vol. 1, 825, 1933) but employs only three instead of thirteen variation parameters and may therefore be more useful in calculating dissociation energies of more complex molecules. R.C.Seymour

539.132

6391. FREE-ELECTRON MODEL OF BENZENE. G.Araki.
Progr. theor. Phys., Vol. 16, No. 3, 212-21 (Sept., 1956).

Lower excited electronic levels of benzene are calculated by assuming π-electrons to move freely in a ring whose perimeter is equal to that of the benzene molecule. The interaction between π-electrons is assumed to be the long-range part separated from the Coulomb interaction by the zero cut-off at 0.46 l of the ring coordinate, where l is the distance between adjacent carbons in the benzene molecule. The configuration interaction with the adjacent levels is taken into account. All interaction integrals can easily be evaluated without any omission. The calculated result agrees fairly well with experiment in spite of simplicity of the model. A.

539.132

6392. ATTEMPT AT INTERPRETATION OF THE ABSORPTION SPECTRA OF CRYSTAL VIOLET AND METHYL VIOLET WITH THE METALLIC MODEL APPROXIMATION, TAKING ACCOUNT OF RAMIFICATIONS. J.Barriol, S.Nikitine and S.G.El Komoss.
Cahiers de Phys., No. 75-76, 67-9 (Nov.-Dec., 1956). In French.

An approximate electronic energy level diagram for crystal violet and methyl violet is given and, with the aid of two disposable parameters, fitted approximately to the experimental data. D.H.Whiffen

539.132

6393. ROTATIONAL TRANSITION OF HYDROGEN MOLECULE BY COLLISION. K.Takayanagi.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 348-54 (May, 1957).

The previous calculation of rotational transition probability for parahydrogen gas is improved by adding an attractive term to the intermolecular potential. Using the result of recent calculations by Evett and Margenau (Abstr. 6160/1953) of intermolecular force, good agreement is obtained between the calculated and experimental values of transition probability. The transition probability is also calculated for H_2–H collisions, because of its importance for the cooling of interstellar matter. According to our present knowledge of the intermolecular forces the H_2–H potential shows much more appreciable anisotropy than does the H_2–H_2 potential, so that H_2–H collisions are much more effective than H_2–H_2 collisions for the rotational transition, nearly 10 times for 100-1000°K. A.

539.132 : 538.222

6394. THE ELECTRONIC STRUCTURE AND MAGNETIC PROPERTIES OF URANYL-LIKE IONS. II. PLUTONYL. J.C.Eisenstein and M.H.L.Pryce.
Proc. Roy. Soc. A, Vol. 238, 31-45 (Dec. 4, 1956).

For Pt I see Abstr. 4854 (1955). The electronic configuration and bonding in $(PuO_2)^{2+}$ are considered. The calculated energy levels can be correlated satisfactorily with the absorption spectrum of $(PuO_2)^{2+}$ in aqueous solution by a plausible choice of numerical parameters. The microwave resonance absorption and paramagnetic susceptibility are derived on the basis of the model, and are in good agreement with experimental results. A.

539.132

6395. STUDIES OF THE JAHN–TELLER EFFECT. I. A SURVEY OF THE STATIC PROBLEM. U.Öpik and M.H.L.Pryce.
Proc. Roy. Soc. A, Vol. 239, 425-47 (Jan. 29, 1957).

According to the Jahn–Teller theorem, symmetrical molecules with degenerate electronic states are unstable. Such molecules therefore take up a distorted shape. If there is near-degeneracy, the symmetrical shape may also be unstable. The distortion in some particular cases was studied. The approach is to minimize the total

electronic energy with respect to distortions of the nuclear framework, the latter being considered to be static. There are always several equivalent distortions of equal energy, so that a static distortion fails to remove the degeneracy. The discussion of dynamic effects is postponed to a subsequent paper. A linear molecule of formula BAB, for which two electronic states of opposite symmetry are sufficiently nearly degenerate, will be stable in a configuration with unequal A–B separations, and unstable when symmetrical. This example illustrates some of the main physical features of Jahn–Teller distortions in a simple manner. Although no example is known where the symmetrical structure is actually unstable, there are examples where the tendency towards distortion noticeably reduces the force constant of the asymmetric vibration. Octahedral complexes AB_6 with degenerate electronic states occur in many situations (e.g. paramagnetic crystals, F-centres, luminescent centres and exciton states in cubic crystals). The orbital degeneracy may be threefold (T_1 and T_2) or twofold. In the former case the stable distortion is found to be either of tetragonal symmetry about a [100] direction, or of trigonal symmetry about a [111] direction. The twofold degenerate situation leads to a more complicated situation. If one neglects anharmonic effects there appears to be an infinity of distortions minimizing the energy; a more detailed consideration of the anharmonic terms shows that the stable distortions are of elongated tetragonal character. This result has an important bearing on complexes involving the cupric ions. A.

539.132 : 539.156

AN EXACT CALCULATION OF SECOND-ORDER LONG-RANGE FORCES. See Abstr. 5580

539.132

6396. EVIDENCE FOR EXCITED STATES OF THE CHEMICAL BOND FROM PARAMAGNETIC ELECTRON RESONANCE. J.Uebersfeld.
Cahiers de Phys., No. 75-76, 61-3 (Nov.-Dec., 1956). In French.

Irradiation of a single crystal of glycine leads to an electron resonance spectrum of greater complexity than the three peaks for polycrystalline material; the single crystal spectrum is anisotropic. The spectrum is believed due to COOH–CH_2. and NH_2. radicals with strong electron exchange. D.H.Whiffen

539.132

6397. PROTON RELAXATION IN H_2O–D_2O MIXTURES CONTAINING PARAMAGNETIC IONS. A.I.Rivkind.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 2, 239-40 (1957). In Russian.

Measurements of T_1 at 230 Oe for protons in H_2O–D_2O mixtures, containing Cr^{+++}, Cu^{++} or Co^{++} ions, show the relaxation time to increase markedly with D_2O content, that for 90% D_2O being about 10 times that for H_2O alone. This unexpected result is believed to be connected with the slow reaction rate of hydrogen bond formation with deuterium. D.H.Whiffen

539.132

6398. THE ELECTRONIC STRUCTURE OF THE OZONE MOLECULE. I.Fischer-Hjalmars.
Ark. Fys., Vol. 11, Paper 5, 529-65 (1957).

A theoretical investigation of the electronic structure of the ozone molecule has been made by the molecular orbital method, based on self-consistent linear combinations of atomic orbitals. The dissociation energy, the dipole moment of the ground state and the transitions to the lowest excited levels have been computed. All computations have been carried out in different approximations, in the simplest case considering only $2p\bar{\pi}$-electrons, in the next approximation considering all the 2p-electrons and in the most accurate treatment considering all 2s- and 2p-electrons. It is found that the $2p\bar{\pi}$- and the 2s,2p-approximations give more reliable results than the 2p-approximation. Energy levels, ionization potentials and transition probabilities are rather similar according to the $2p\bar{\pi}$- and the 2s,2p-approximations, but dipole moment and details of the electron distribution as given by population analysis are quite different in the different approximations. The results of the computations in the 2s,2p-approximation agree comparatively well with experiments. The excellent agreement between computed and experimental dissociation energy is, however, believed to be fictitious, as inclusion of 1s-electrons will possibly change the energy values by several electron volts. The computed dipole moment has the expected sign and approximately the correct magnitude. Computed electron transitions have been tentatively assigned to observed absorption bands. A.

539.132

6399. PURE QUADRUPOLE RESONANCES IN MULTIBROMOBENZENES. P.A.Cassabella, P.J.Bray, S.L.Segel and R.G.Barnes.
J. chem. Phys., Vol. 25, No. 6, 1280-1 (Dec., 1956).

Values are given for the quadrupole resonance frequencies of Br^{81} in hexabrom-, ortho dibrom- and 1,2,3,5 tetrabrom-benzene. They are discussed together with earlier results on brominated benzenes and it is shown that increase in the number of Br increases the quadrupole coupling and that ortho substitution has a specially large effect. D.H.Whiffen

539.132

6400. FREQUENCY DEPENDENCE OF PROTON SPIN RELAXATION IN AQUEOUS SOLUTIONS OF PARAMAGNETIC IONS. A.W.Nolle and L.O.Morgan.
J. chem. Phys., Vol. 26, No. 3, 642-8 (March, 1957).

Magnetic resonance relaxation times T_1 and T_2 were measured for protons in aqueous solutions of $Cr(H_2O)_6^{+++}$, $Mn(H_2O)_x^{++}$, $Co(H_2O)_x^{++}$, and $Nd(H_2O)_x^{++}$ in the frequency range 2.7 to 28.7 Mc/s. T_1 was observed to decrease with decreasing frequency for the first two ions, but not the last two, while T_2 was essentially constant for each ion. The abnormally large values of T_1/T_2 which have been previously reported appear as a result of the effect at high frequencies. Those observations are interpreted in terms of a theoretical model of the magnetic interaction between ion and proton in which a random thermal process is presumed to occur with a characteristic correlation time, τ_e, of 10^{-8} to 10^{-11} sec. A.

539.132 : 539.133

6401. PROTON RESONANCE IN GUANIDINE ALUMINUM SULFATE HEXAHYDRATE. R.D.Spence and J.Muller.
J. chem. Phys., Vol. 26, No. 3, 706 (March, 1957).

Proton nuclear resonance spectra indicate six H_2O molecules coordinated about each Al with a 3-fold symmetry axis through the Al and coincident with the crystallographic c axis. D.H.Whiffen

539.132

6402. OBSERVATION OF CHEMICAL SHIELDING AND SPIN COUPLING OF C^{13} NUCLEI IN VARIOUS CHEMICAL COMPOUNDS BY NUCLEAR MAGNETIC RESONANCE. C.H.Holm.
J. chem. Phys., Vol. 26, No. 3, 707-8 (March, 1957).

A table of chemical shifts relative to benzene from -0.90×10^{-4} in carbonyl carbon of α hydroxy acids to $+1.90 \times 10^{-4}$ in CH_2I_2 all for C^{13} in natural abundance. The thermal relaxation times were several minutes and the observations made in the dispersion mode. Spin–spin couplings for saturated C^{13}–H bonds are 140-170 c/s and for unsaturated cases 180-210 c/s. The C^{13}–F coupling is 600 ± 20 c/s in fluorobenzenes. D.H.Whiffen

539.132 : 541.18

6403. SPIN–ORBITAL PERTURBATION IN CYANINE DYES ADSORBED ON SURFACES CONTAINING HIGH-Z ATOMS. E.Clementi and M.Kasha.
J. chem. Phys., Vol. 26, No. 4, 956-7 (April, 1957).

Spectral emission properties at 77°K of monolayers of certain cyanine dyes adsorbed on silica gel, alumina and lead bromide show strong spin–orbital perturbation only in the case of $PbBr_2$. This adsorption spin–orbital perturbation may play a part in the dye-sensitization of photographic emulsions. R.C.Seymour

539.13

6404. PROTON MAGNETIC RESONANCE SPECTRUM OF NAPHTHALENE. H.J.Bernstein, W.G.Schneider and J.A.Pople.
J. chem. Phys., Vol. 26, No. 4, 957-8 (April, 1957).

The spectrum is resolved into 12 lines and fitted to a chemical shift and coupling scheme. The chemical shift between distinguishable protons is 13.2 c/s at 40 Mc/s. Spin–spin coupling between protons at positions 1 and 2 is 8.6, at 2 and 3 is 6.0 and at 1 and 3 1.4 c/s; all other distinguishable coupling types are zero. D.H.Whiffen

539.13

6405. MOLECULAR TRANSFER OF NON-EQUILIBRIUM NUCLEAR SPIN MAGNETIZATION. H.M.McConnell and D.D.Thompson.
J. chem. Phys., Vol. 26, No. 4, 958-9 (April, 1957).

If two distinguishable nuclear magnetic resonance signals are possible in A and B systems where there is chemical exchange between A and B at a rate T_e^{-1} then saturation of signal A leads to saturation of B at a rate equal to the exchange rate. If the B signal is observed at time τ after saturation of A then this signal is zero if $T_e \ll \tau$, is normal if $T_e \gg \tau$ and intermediate if $T_e \sim \tau$ always provided $\tau \ll T_1$. The extension to three component systems is given and the effect observed in NH_4^+. D.H.Whiffen

539.132

6406. ADIABATIC COUPLING BETWEEN ELECTRONIC AND NUCLEAR MOTION IN MOLECULES. A.Dalgarno and R.McCarroll.
Proc. Roy. Soc. A, Vol. 237, 383-94 (Nov. 6, 1956).

The coupling between electronic and nuclear motion in diatomic molecules is investigated, particular attention being devoted to configurations in which the nuclei are separated by large distances. The analysis shows that at these distances nuclear–electronic coupling causes to a first approximation a change in potential energy of the order (m/M) times the kinetic energy of the electrons, m being the electronic mass and M the nuclear mass, provided that the molecule separates into atoms in S states. For such cases, nuclear–electronic coupling can in general be ignored, but if at least one of the separated atoms is in a state of non-zero orbital angular momentum, coupling introduces terms which are not negligible compared to the usual van der Waals interaction. Quantitative results over all nuclear separations are given for the $1s\sigma_g$ and $2p\sigma_u$ states of H_2^+ and the $^1\Sigma_g$ and $^3\Sigma_u$ states of H_2, the $1s\sigma_g$ state of H_2^+ being investigated in detail using both exact and approximate solutions of the static (or fixed nuclei) equation in order to assess the error involved in the use of the latter. Accurate asymptotic expressions valid in the limit of large nuclear separations are obtained for the $1s\sigma$ and $2p\sigma$ states of H_2^+ and if HeH^{2+}, and a brief discussion is also given of the inert gas molecules. A.

539.132

6407. ADIABATIC COUPLING BETWEEN NUCLEAR AND ELECTRONIC MOTION IN MOLECULES. II.
A.Dalgarno and R.McCarroll.
Proc. Roy. Soc. A, Vol. 239, 413-19 (March 12, 1957).

The adiabatic coupling between nuclear and electronic motion is investigated for diatomic molecules which at infinite separation consist of two atoms at least one of which has non-zero orbital angular momentum, and as an example quantitative results at all nuclear separations R are given for the $2p\pi_u$ state of H_2^+. Several other systems are considered, but attention is restricted to configurations in which R is sufficiently large that the adiabatic coupling effect may be represented by an expansion in powers of R^{-1} with leading term proportional to R^{-2}. Some consequences of an R^{-2} interaction are briefly discussed and finally the generalization to include spin angular momentum is indicated. A.

539.132

6408. MEASUREMENT OF THE HYPERFINE STRUCTURE OF POTASSIUM FLUORIDE WITH THE MOLECULAR BEAM RESONANCE METHOD. C.Schlier.
Z. Phys., Vol. 147, No. 5, 600-27 (1957). In German.

The hyperfine structure spectrum of KF in the megacycle region was measured with a molecular beam resonance method using 4-pole focusing fields to obtain high beam intensities. The spectra were obtained in both weak, $eqQ \gg \mu^2E^2/B \gg c$, and very weak, $c \gg \mu^2E^2/B$ Stark fields. Full experimental and theoretical details are given including the theory of the high-frequency Stark effect and of double quanta transitions. The results are: Quadrupole coupling $eqQ_K/h = -7934.7 \pm 1.1 + (95.6 \pm 0.4)\ v$ Mc/s, where v = 0,1,2 being the vibrational quantum number. Magnetic nuclear spin–rotation interactions $c_F/h = +10.55 \pm 0.07$ kc/s and $c_K/h = +380 \pm 97$ c/s. D.H.Whiffen

539.132

6409. RELATION BETWEEN THE FREE ELECTRON MODEL AND LCAO MOLECULAR ORBITALS. S.Regnier and J.Barriol.
Cahiers de Phys., No. 75-6, 63-4 (Nov.-Dec., 1956). In French.

Absorption frequencies of conjugated compounds can be calculated quite effectively by using for the first excited MO the approximation $\Phi_1 = x\Phi_0/C$, Φ_0 being the highest occupied MO, x the cartesian coordinate and C a normalizing constant. Then the absorption frequency depends only on the molecular geometry, like the corresponding free-electron expression. See Abstr. 10407 (1954), 1447 (1956). J.Hawgood

539.132 : 539.153.4

6410. DELTA-FUNCTION-MODEL. I. ELECTRONIC ENERGIES OF HYDROGEN-LIKE ATOMS AND DIATOMIC MOLECULES.
A.A.Frost.
J. chem. Phys., Vol. 25, No. 6, 1150-4 (Dec., 1956).

The electron in a one-electron atom or diatomic molecule is considered to move in one dimension on a line through the nuclei. The potential energy is taken as zero except at the nuclei where it goes to minus infinity as negative delta-functions. The exact solution is easily obtained with the wave-function accurately expressible as a linear combination of atomic orbitals. In contrast to the free-electron model this method handles heteronuclear molecules, does not arbitrarily limit the coordinate, and can predict ionization energies. A.

539.132

6411. DELTA-POTENTIAL-FUNCTION MODEL. II. AROMATIC HYDROCARBONS. A.A.Frost and F.E.Leland.
J. chem. Phys., Vol. 25, No. 6, 1154-60 (Dec., 1956).

The π electrons are considered as following a one-dimensional network through the molecule as in the free-electron model. The potential energy is taken as zero everywhere except at each π–carbon nucleus where it goes to minus infinity as a negative delta-function. By a procedure of linear combination of atomic orbitals, suitably defined, exact solutions of the Schrödinger equation are easily obtained. Negative one-electron energy levels, of which there may be as many as there are π–carbon nuclei, are interpreted as bound states, with energy zero or positive as ionized states. This model stands between the free-electron model on the one hand and the LCAO molecular orbital model on the other. It goes beyond the former in that it can predict not only excitation energies and resonance energies, but also ionization potentials. It surpasses the latter in that exact solutions are obtainable. Numerical results are qualitatively of the right order of magnitude after adjustment of the strength of the delta-function which is the one and only variable parameter. A.

539.132 : 541.5

6412. BOND LOCALIZATION AND THE HYPERCONJUGATIVE EFFECT IN THE AROMATIC CARBONIUM IONS. T.Morita.
J. chem. Phys., Vol. 25, No. 6, 1290 (Dec., 1956).

The semi-empirical LCAO MO theory is used to discuss the amount of hyperconjugation in these ions, to assist interpretation of the blue-shifts on methylation. In benzenium and toluenium a localized bond model seems better, but in mesitylenium hyperconjugation must be introduced. Similar calculations on xylene carbonium ions suggest that the m-isomer is more hyperconjugated than the o- or p-isomers. J.Hawgood

539.132

6413. APPROXIMATE MOLECULAR ORBITALS.
A.Dalgarno, B.L.Moiseiwitsch and A.L.Stewart.
J. chem. Phys., Vol. 26, No. 4, 965-6 (April, 1957).

A summary of the main conclusions of a series of papers (Abstr. 6060/1956) on the accuracy of approximate wave-functions of the type $\Psi_t = \Psi_u + p\Psi_s$ for He_2^+ and HeH^{2+}, where Ψ_u results from a united atom approximation, Ψ_s is the LCAO and p is determined by use of the variation principle. R.C.Seymour

539.132

6414. APPLICATION OF CONFIGURATION INTERACTION TO THE H_3 COMPLEX. B.J.Ransil.
J. chem. Phys., Vol. 26, No. 4, 971 (April, 1957).

Describes briefly exact LCAO-MO calculations on the linear symmetrical H_3 complex, using identical 1s orbitals and varying the charge z and H-H distance R. A conventional single determinant gave binding energy relative to three H atoms as BE = 39.3 kcal with equilibrium distance R_e = 1.95 a.u. for z=1, and BE = 41.1, R_e = 2.0 for z = 0.95. Configuration interaction between the MO's built from 1s AO's gave BE = 60.7 for z = 1, and no improvement for change of z. Use of a single determinant with different space MO's for opposite spins gave BE = 47.5 kcal. J.Hawgood

539.132

6415. PAIRING ENERGIES IN THE ACTINIDE SERIES.
J.S.Griffith and L.E.Orgel.
J. chem. Phys., Vol. 26, No. 5, 988-92 (May, 1957).

The authors' previous calculations of pairing energies for d^n configurations are extended to f^n configurations. The ground state of f^2, as in PuF_6, is shown to be nondegenerate whether the spins are paired or not. However, detailed calculations show the magnetic properties to favour the view that the spins are in fact paired. This assumption is also found to accord with the observed variation of vibrational frequencies for UF_6, NpF_6, and PuF_6. A.

539.132 : 539.153.4

6416. THE DENSITY MATRIX IN SELF-CONSISTENT FIELD THEORY. II. APPLICATIONS IN THE MOLECULAR ORBITAL THEORY OF CONJUGATED SYSTEMS. R.McWeeny.
Proc. Roy. Soc. A, Vol. 237, 355-71 (Nov. 6, 1956).

The methods of a previous paper (Abstr. 6061/1956) are applied

in the theory of conjugated systems. The density matrix — which in this case is the array of "charges" and "bond orders" — may be calculated for a general π-electron system, in self-consistent field (s.c.f.) approximation, by iterative refinement of an initial estimate. In choosing an initial estimate it is possible to make use of known Hückel theory solutions for simple hydrocarbons, building up approximations for the more complicated systems by changing parameters (describing, for example, the insertion of hetero-atoms or the interconnection of different fragments). This may be done by a density-matrix perturbation method which avoids all reference to the wave-function itself. In this way, Hückel approximations for rather general systems can be written down with very little calculation, and at the same time, there are interesting chemical applications along the lines of Coulson and Longuet-Higgins (1947,1948). Finally, self-consistency can be introduced and the perturbation method can be carried over into the s.c.f. theory; this permits a rather more realistic discussion of chemical properties and explains the success, in certain cases, of the simple Hückel approach. A.

539.133 : 535.32

6417. CONTRIBUTION TO THE STUDY OF OPTICAL ANISOTROPY AND OF MOLECULAR ORIENTATION.
P.Bothorel, A. Pacault and A.Rousset.
Cahiers de Phys., No. 71-72, 66-8 (July-Aug., 1956). In French.

The molecular refractions and bond angles of benzene, diphenyl, diphenylethane, diphenylmethane and triphenylmethane are tabulated. The minimum distance between two hydrogen atoms in diphenylmethane and triphenylmethane is in good agreement with the value of $2r_H$. G.I.W.Llewelyn

539.133

6418. DIPOLE MOMENTS OF TRI-SUBSTITUTED BENZENES. I.
D.V.G.L.Narasimha Rao.
Indian J. Phys., Vol. 30, No. 11, 582-3 (Nov., 1956).

539.133

6419. DIPOLE MOMENTS OF TRI-SUBSTITUTED BENZENES. II.
D.V.G.L.Narasimha Rao.
Indian J. Phys., Vol. 31, No. 1, 60 (Jan., 1957).

539.133 : 548.737

6420. CRYSTAL AND MOLECULAR STRUCTURES OF HETEROCYCLIC COMPOUNDS. III. α-PHENAZINE NEAR 80°K.
F.L.Hirshfeld and G.M.J.Schmidt.
J. chem. Phys., Vol. 26, No. 4, 923-9 (April, 1957).

A partial three-dimensional analysis of the crystal structure of α-phenazine at the temperature of boiling nitrogen has yielded, after refinement by a weighted least-squares procedure, carbon and nitrogen coordinates accurate to 0.003 A as well as approximate hydrogen positions. Within the experimental error, the C—C bond lengths are identical with those in anthracene. This agrees with theoretical predictions, for direct molecular-orbital calculations, with allowance for overlap of adjacent atomic orbitals, indicate a maximum difference between corresponding C—C bond lengths in phenazine and anthracene of about 0.01 A, which is of the order of the error in the latter structure. The results imply that neither inductive effects due to chemical substitution nor crystal forces can have any great influence on bond lengths in an alternant hydrocarbon such as anthracene. The C—H bond lengths average 1.00 A but are not to be compared with direct measurements of the internuclear distance such as are given by electron-diffraction or magnetic-resonance data. Deviations from molecular symmetry mmm exceed the experimental error only in the direction normal to the mean molecular plane. These displacements from the plane are of the order of 0.01 A and appear to arise from an electrostatic attraction between overlapping atoms in adjacent parallel molecules. Electrostatic interaction, however, is probably not important in determining the type of crystal packing, for a survey of other aromatic structures indicates that the packing type is, in most instances, approximately independent of electrostatic forces. A.

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1 : 535

6421. CONTRIBUTIONS OF OPTICAL METHODS TO NUCLEAR PHYSICS. G.Breit.
J. Opt. Soc. Amer., Vol. 47, No. 6, 446-59 (June, 1957).

A general review of developments in nuclear physics which have resulted from the application of optical methods to the study of nuclei. It also touches upon some related developments which have resulted from applications of atomic beams which have been stimulated by the early spectroscopic ideas as well as by the results of spectroscopic research. Some items under consideration are: coupling of electron system to nuclear spin, the electron—nuclear volume and shape effect, the hyperfine structure of the isotopes of hydrogen, distribution of nuclear magnetic, isotope shift and quadrupole moments, bearing of latter on nuclear models. A.

539.152.1

6422. RELATIVISTIC EFFECTS IN HEAVY NUCLEI. G.Marx.
Nuclear Physics, Vol. 1, No. 9, 660-9 (Aug., 1956).

The binding energy of a model nucleus is discussed in a zero-range scalar field of nuclear forces keeping the relativistic effects in view. According to these results the scalar field free from exchange forces may account for the saturation of the binding energy, in contrast to the conclusions drawn from calculations based on a non-relativistic approach. From the point of view of quantum theory these considerations are of an approximate character; they may, however, serve as evidence for the decisive role which relativistic effects may play in the theory of heavy nuclei. A.

539.152.1

6423. THE COMPETITION BETWEEN NUCLEAR SHELLS IN MAYER'S MODEL. N.Zeldes.
Nuclear Physics, Vol. 2, No. 1, 1-64 (Sept., 1956).

Some regularities in nuclear shell filling and in nuclear energy level systematics are explained in Mayer's single-particle model. A.

539.152.1

6424. NUCLEAR SPIN—ORBIT ENERGY FOR OSCILLATOR WAVE FUNCTIONS. J.Hope.
Phys. Rev., Vol. 106, No. 4, 771-4 (May 15, 1957).

Matrix elements of the two-body spin—orbit interaction between two-nucleon states in LS-coupling are expressed in a convenient form which is particularly suitable for oscillator wave-functions. The interaction between an almost-closed shell and an external inequivalent nucleon is also considered. A.

539.152.1

6425. THE COLLECTIVE MODEL OF NUCLEAR MOTION.
R.E.Peierls and J.Yoccoz.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 381-7 (May, 1957).

Collective motions of a many-body system, such as translation, rotation and oscillation, may be incorporated approximately in a shell-model description by regarding the shell-model wave-function as a trial function for a variational approach, and exploiting the fact that the expectation value of the energy is then independent of the location and orientation, and approximately independent of the size and shape of the potential well. If these degeneracies are removed in the usual way, one is led naturally to wave-functions containing both shell-model and collective aspects and to approximate values for the translational, rotational and vibrational energies. A.

539.152.

6426. ON THE MOMENTS OF INERTIA OF NUCLEI. J.Yoccoz.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 388-97 (May, 1957).

The variational method developed in the preceding abstract is applied to the calculation of nuclear moments of inertia using an anisotropic harmonic well and neglecting spin—orbit couplings. The inter-nucleon forces are assumed to have a Gaussian form, either with zero range or with a realistic range, and in the latter case either for ordinary (Wigner) forces or for a Serber mixture. While with such a crude model no detailed agreement can be expected the orders of magnitude and the trend of the results are encouraging A.

539.152.1

6427. SURFACE RIGIDITY AND SHELL STRUCTURE OF NUCLEI. T.Marumori, S.Suekane and A.Yamamoto.
Progr. theor. Phys., Vol. 15, No. 6, 582-3 (June, 1956).

The surface rigidity of nuclei has been calculated for nucleons in a spheroidal well. It is found, that the values of the surface rigidity of closed-shell nuclei are very large except for neutron and proton numbers 28; that the values of the surface rigidity for the subshells between neutron and proton numbers 50 and 82 become very small irrespective of the possible choices of level ordering, whilst between proton and neutron number 82 and 126 it is very small except for a particular choice of level ordering. L.L.Gree

539.152.1

6428. NUCLEAR QUADRUPOLE MOMENT AND THE RIGIDITY OF THE NUCLEAR CORE. T.Marumori, S.Suekane and A.Yamamoto.
Progr. theor. Phys., Vol. 15, No. 6, 584-5 (June, 1956).

The electric quadrupole moments of core ±one extra particle type of nuclei are analysed using the results of the preceding abstract. The rapid variations of rigidity required to explain the experimental results are explained in terms of the shell structure of the core.

L.L.Green

539.152.1

6429. ON QUANTUM-MECHANICAL NUCLEAR DIPOLE VIBRATIONS. J.Fujita.
Progr. theor. Phys., Vol. 16, No. 2, 112-30 (Aug., 1956).

The semi-classical collective model of nuclear photoeffect, which assumes the existence of nuclear dipole vibration, is reformulated quantum-mechanically according to the Tomonaga's general prescription, and a modified collective model is proposed, which takes into account the velocity-dependent character of neutron—proton exchange forces. The experimental and theoretical evidence for the validity of the dipole vibration model are discussed. A.

539.152

6430. NUCLEAR DEFORMABILITY AND SHELL STRUCTURE. T.Marumori, S.Suekane and A.Yamamoto.
Progr. theor. Phys., Vol. 16, No. 4, 320-40 (Oct., 1956).

The connection between the surface rigidity of the nuclear core, which has been accounted for in terms of the surface tension of liquid-drop nuclei, and its proper shell structure is discussed by using the method of the quantum-mechanical description of the collective motion proposed by one of the present authors and by others. The surface rigidity of the core can be calculated, provided that the shell model is valid for the behaviour of particles forming the core. The notable features of the results obtained are that the calculated values of rigidity of cores are, in general, considerably larger than those due to the hydrodynamical estimation, and are closely related to the proper shell structures of cores. Such a characteristic variation of the rigidity of cores is discussed in detail by comparing with the quadrupole moments of the "core ± one extra-particle type" nuclei. Theoretical quadrupole moments thus obtained explain well the observed values which have been noticed to depend on the shell structure. The rigidity of a core with a large deformation is discussed. A.

539.152.1

6431. COLLECTIVE NUCLEAR MOTION AND THE EFFECTIVE MASS OF A NUCLEON. R.J.Blin-Stoyle.
Nuclear Physics, Vol. 2, No. 2, 169-72 (Oct., 1956).

It is suggested that the energies of rotational levels in nuclei indicate that the effective mass of a nucleon in a nucleus is approximately one-half the actual mass. A.

539.152.1

6432. MEAN SQUARE RADIUS OF THE DEUTERON. J.S.Levinger and M.L.Rustgi.
Phys. Rev., Vol. 106, No. 3, 607 (May 1, 1957)

It is pointed out that two analyses of deuteron photoeffect data permit the mean square radius to be evaluated (154-155 mb), thus allowing only small latitude in the value of Newton's adjustable parameter C (Abstr. 5392/1957). J.J.Wilkins

539.152.1

6433. INVESTIGATION OF COULOMB EXCITATION OF NUCLEI BY NITROGEN IONS.
D.G.Alkhazov, D.S.Andreyev, A.P.Greenberg and I.K.Lemberg.
Nuclear Physics, Vol. 2, No. 1, 65-80 (Sept., 1956).

The ratio of the cross-sections for Coulomb nuclear excitation by heavy particles and protons has been computed. It is shown that in many cases it is more profitable to use heavy ions than protons for Coulomb excitation of nuclei. Preliminary results of a study of Coulomb excitation of a number of nuclides with 15.6 MeV nitrogen ions are presented. A.

539.152.1

6434. ELECTRICAL OCTUPOLE COULOMB EXCITATION IN RHODIUM. G.A.Jones and W.R.Phillips.
Proc. Roy. Soc. A, Vol. 239, 487-95 (April 9, 1957).

The electric octupole excitation of the 40 keV isomeric state in Rh^{103} has been observed with protons of energies 700 to 1200 keV. The energy dependence of the cross-section is consistent with that predicted by the W.K.B. treatment of Alder and Winther. The absolute cross-section is about three times that expected theoretically. Possible explanations for this discrepancy are suggested. A.

539.152.1

6435. STUDY OF NUCLEAR STRUCTURE BY ELECTROMAGNETIC EXCITATION WITH ACCELERATED IONS.
K.Alder, A.Bohr, T.Huus, B.Mottelson and A.Winther.
Rev. mod. Phys., Vol. 28, No. 4, 432-542 (Oct., 1956).

The classical and quantum theory of Coulomb excitation of nuclei are given. Expressions for cross-sections and angular correlations are derived and the results presented in tabular and graphical form for the various orders of multipole excitation. A review of the experimental techniques for studying Coulomb excitation is given with a summary of the results already obtained by this method. The theory of nuclear collective excitation is summarized.

L.L.Green

539.152.1 : 539.172.3

ELECTRIC QUADRUPOLE TRANSITIONS IN THE NUCLEAR PHOTOEFFECT. See Abstr. 5631

539.152.1

6436. PROPERTIES OF LOW LYING LEVELS IN Mg^{25}.
H.E.Gove, G.A.Bartholomew, E.B.Paul and A.E.Litherland.
Nuclear Physics, Vol. 2, No. 2, 132-46 (Oct., 1956).

The reaction $Mg^{25}(pp'\gamma)Mg^{25}$ and the negaton decay of Na^{25} have been used to study the first four excited states of Mg^{25} at 0.58, 0.98, 1.61, and 1.96 MeV. The 0.98 MeV level decays to the level at 0.58 MeV or to ground by gamma emission in the intensity ratio 51 : 49. The 1.61 MeV level decays to ground > 96% of the time. The 1.96 MeV level decays to the level at 0.98 MeV or 0.58 MeV or to ground in the intensity proportions 25 : 50 : 25. A study of the gamma-rays following negaton decay of Na^{25} shows that the levels in Mg^{25} at 0.98 and 1.61 MeV are fed by negaton transitions. Gamma-rays due to negaton transitions to the 0.58 state are less than 3% of the total. Comparison between the gamma-ray branching ratios of levels in Mg^{25} and those in Al^{25} indicate that the 0.58, 0.98 and 1.96 MeV levels in Mg^{25} have spins and parities 1/2+, 3/2+ and 5/2+ respectively, while that at 1.61 MeV is probably 7/2+. The most likely spin and parity assignments for the ground state of Na^{25} are 5/2+. A.

539.152.1

6437. ENERGY LEVELS IN Pb^{205} FROM THE DECAY OF Bi^{205}. M.Schmorak, R.Stockendal, J.A.McDonell, I.Bergström and T.R.Gerholm.
Nuclear Physics, Vol. 2, No. 3, 193-225 (Nov., 1956).

The energies, spins and parities of 9 excited states in Pb^{205} and the probable energies of 8 additional states have been established by studies of 14.5 day Bi^{205} decay. The experiments include precision energy measurements on conversion lines in permanent magnet and double-focusing spectrometers; measurements of coincidences between pairs of conversion lines in a double long lens spectrometer, and coincidences between high energy gamma-rays and low energy conversion lines in the same spectrometer adapted for the purpose; measurements of relative gamma intensities in a scintillation spectrometer. Positons were discovered with a maximum energy of 925 keV, establishing the total decay energy of Bi^{205} as 2.65 MeV. The proposed decay scheme contains 28 of the observed transitions and is discussed in the light of the shell model. A.

539.152.1

6438. THE ENERGY LEVELS OF Pb^{205}. M.H.L.Pryce.
Nuclear Physics, Vol. 2, No. 3, 226-38 (Nov., 1956).

The energy levels of Pb^{205} are calculated on the shell model, regarding Pb^{208} as three holes in the double closed shell nucleus Pb^{208}. Using energies for single holes derived from data on Pb^{207}, and parameters for their pairwise interaction derived from Pb^{206}, the levels up to 2.6 MeV have been estimated. A.

539.152.1

6439. MAGNETIC PROPERTIES OF F^{19} IN THE 197 keV NUCLEAR LEVEL. P.B.Treacy.
Nuclear Physics, Vol. 2, No. 3, 239-53 (Nov., 1956).

Gamma-rays are observed from the de-excitation of the second excited state of F^{19} produced by inelastic proton scattering. It is found that anisotropy of this radiation is quenched by a uniform magnetic field applied normal to the proton beam, and a measurement of this effect yields the following value for the nuclear spectroscopic splitting factor: $g_I = 1.8 \pm 0.4$. The degree of anisotropy cannot be influenced by a field applied parallel to the proton beam in the case of solid NaF and MnF_2 targets, but with a gas target of CF_4 such a field restores the undisturbed distribution. This effect is analysed with the aid of energy-loss data and implies as an order of magnitude a hyperfine structure constant $a = 0.2 \times 10^{-18}$ erg for the free F^{19} in its ground $P_{3/2}$ state. A.

539.152.1

6440. THE POSSIBLE EXISTENCE OF ROTATIONAL LEVELS IN Al^{28}. R.K.Sheline.
Nuclear Physics, Vol. 2, No. 4, 382-94 (Dec., 1956).

The nine lowest levels in Al^{28} are interpreted as belonging to 4 rotational bands which in turn arise from two nuclear configurations. Experimental evidence from the beta decay of Mg^{28} and from the (d,p) stripping reaction on Al^{27}, including the spins, parities and energies of levels, the calculated moments of inertia of the bands, and the relative intensities of the beta and gamma transitions, is shown to be in excellent agreement with the interpretation. The nuclear configurations are shown to be consistent with experimental evidence and to arise naturally from the S.G.Nilsson levels for deformed nuclei. General trends in deformation in the low A region are discussed. A comparison is made between the moments of inertia of even–even, odd mass, odd–odd nuclei, and the corresponding calculated rigid moments of inertia. A.

539.152.1

6441. ENERGY LEVELS OF Pb^{206}. M.J.Kearsley.
Phys. Rev., Vol. 106, No. 2, 389 (April 15, 1957).

Theoretical. The positions of the low-lying levels in Pb^{206} have been calculated assuming single hole energies taken from the empirically known levels in Pb^{207}, modified by the energy of interaction between the holes. For the latter, harmonic oscillator wave-functions are used, and the interaction assumed contains the usual Rosenfeld central exchange mixture and a Yukawa-type potential of range 1.37×10^{-13} cm and strength V_C left as a parameter to be determined. Configuration interaction is taken into account. The energies of the first seven excited states of Pb^{206} are predicted within 0.1 MeV and with the correct spins and parities, if V_C is taken as 70 MeV. J.W.G.Wignall

539.152.1

6442. NUCLEAR LEVELS IN Si^{28} AND P^{31}.
P.M.Endt and C.H.Paris.
Phys. Rev., Vol. 106, No. 4, 764-6 (May 15, 1957).

Lead phosphate targets have been bombarded with protons accelerated by an electrostatic generator to energies of 6.5 and 7.0 MeV. Charged reaction products (alpha-particles and elastically and inelastically scattered protons) were observed at 50, 90, and 130 degress to the proton beam with a high-resolution magnetic analyser. The ground-state Q-value of the $P^{31}(p,\alpha)Si^{28}$ reaction has been measured as 1.909 ± 0.010 MeV. Levels were observed in Si^{28} at 1.771 and 4.617 MeV and in P^{31} at 1.267, 2.234, 3.133, 3.293, 3.414, 3.505, 4.188, 4.257, 4.430, 4.590, 4.633, 4.784, and 5.012 MeV. A.

539.152.1

6443. SOME REMARKS ON THE NUCLEAR LEVEL SPACING.
Y.Fujimoto, F.Fukuzawa and S.Okai.
Progr. theor. Phys., Vol. 16, No. 3, 246-8 (Sept., 1956).

It is pointed out that the distribution of level spacings (relative to the average level spacing for each nuclide) derived from slow-neutron resonance experiments is exponential; this corresponds to a priori random distribution of levels. J.W.G.Wignall

539.152.1

6444. INVESTIGATION OF THE ENERGY LEVELS OF THE F^{20} NUCLEUS BY MAGNETIC ANALYSIS. L.M.Khromchenko.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 194-8 (1957). In Russian.

The products of the reaction $F^{19}(d,p)F^{20}$ were studied by applying the magnetic analysis method. In the investigated excitation energy range (up to 6.75 MeV) 24 proton groups were recorded which determine the ground state and 23 excitation levels of the F^{20} nucleus. Six of these levels with excitation energies 4.55, 4.86, 5.41, 5.54, 6.07 and 6.36 MeV have not been observed previously. The $E^* = 6.74$ MeV level in the (d,p) reaction has likewise not been observed previously but the relatively close F^{20} level has been detected in investigations on resonance scattering of neutrons. A.

539.152.1

6445. SOME CASES OF VERY SMALL LIFETIMES OF LOW NUCLEAR LEVELS. É.E.Berlovich and G.V.Dubinkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 223-6 (1957). In Russian.

The lifetimes of short-lived excited states of nuclei were studied by the delayed coincidence method. The lifetimes of the lower levels of the Ti^{46} and Mo^{95} nuclei were found to be less than 10^{-10} sec. The experimental half-life of the excited state of the Tl^{203} nucleus was found to be $(2.9 \pm 0.3) \times 10^{-10}$ sec, a result which does not agree with that of de Waard (Abstr. 9851/1955). The method applied by de Waard is discussed. The partial half-times for magnetic dipole and electric quadrupole transitions are compared with the values predicted by the formulae of the single-particle model. A.

539.152.1 : 539.172.13

NUCLEAR ENERGY LEVELS FROM Be^9, B^{10}, Mg^{24} (d,p) REACTIONS. See Abstr. 5625

539.152.1

6446. INVESTIGATION OF THE NUCLEAR ISOMER Hf^{180m}. V.S.Gvozdev and L.I.Rusinov.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 3, 401-4 (1957). In Russian.

Study of the L-shell conversion coefficient indicates that the transition between the isomeric level at 1142.9 keV and the 8+ level at 1085.3 keV is an E1 transition; hence, the level is thought to be 9–. The transition is about 10^{16} times weaker than predicted for a single particle transition. It is suggested that the 9– level is the first level of a new system of rotational levels. G.E.Brown

539.152.1

6447. UPPER LIMITS FOR THE LIFETIMES OF EXCITED STATES OF Fe^{56} AND Ti^{46}. G.Bertolini.
Nuclear Physics, Vol. 2, No. 6, 660-3 (Feb., 1957).

An electronic time-analyser has been used to place an upper limit of 10^{-11} seconds on the lifetime of two excited states of Fe^{56} and one of Ti^{46}. These results confirm the E2 character of the γ-rays emitted from these states. J.M.Cassels

539.152.2

6448. HYPERFINE STRUCTURE IN PARAMAGNETIC RESONANCE. NUCLEAR SPIN AND MAGNETIC MOMENT OF 5.3-YEAR RADIOACTIVE ISOTOPE Eu^{152}. A.A.Manenkov, A.M.Prokhorov, P.S.Trukhlyaev and G.N.Yakovlev.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 4, 623-5 (1957). In Russian.

Electron resonance experiments on Eu^{++} in SrS crystals at 9343 Mc/s enriched in 5.3-year Eu^{152} show I = 3 and $|\mu| = 2.03$ n.m. for this isotope, the moment being based on Eu^{151} $\mu = 3.6$ n.m. D.H.Whiffen

539.152.2

6449. ODD-ODD ISOTOPE HAVING ZERO SPIN. J.C.Hubbs, W.A.Nierenberg, H.A.Shugart and J.L.Worcester.
Phys. Rev., Vol. 105, No. 6, 1928-9 (March 15, 1957).

The nuclear angular momenta of two neutron-deficient isotopes of Ga were determined by the atomic-beam magnetic-resonance method; for 9.4 hr Ga^{66}, I = 0 (probably; the magnetic dipole moment of the $^2P_{1/2}$ state is $\leq 10^{-3}$ nuclear magnetons) and for 78 hr Ga^{67}, I = 3/2. A.O.Stanesby

539.152.2

6450. ANALYSIS OF NUCLEAR QUADRUPOLE MOMENTS ON THE BASIS OF A KINEMATICAL MODEL.
R.K.Osborn and E.D.Klema.
Nuclear Physics, Vol. 2, No. 4, 454-75 (Dec., 1956).

The kinematical model used previously (Abstr. 560/1956) in the correlation of nuclear magnetic moments has been applied to the analysis of nuclear quadrupole moments. The empirical rules found in the previous work are in general confirmed; however, the $d_{3/2}$ nuclei form an exceptional group and are discussed in detail. A possible explanation of the anomalous magnetic moment of W^{183} is given. Shape factors are obtained for a number of odd mass nuclei on the basis of the present model. A.

539.152.2

6451. MAGNETIC MOMENT AND SPIN OF $_{40}Zr^{91}_{51}$.
E.Brun, J.Oeser and H.H.Staub.
Phys. Rev., Vol. 105, No. 6, 1929-30 (March 15, 1957).

Measurements on $(NH_4)_2ZrF_6$ in saturated D_2O solution using a Bloch-type nuclear resonance spectrometer gave a magnetic moment $\mu(Zr^{91}) = -1.30284 \pm 0.00002$ nuclear magnetons; the measurements are compatible with a spin of 5/2. A.O.Stanesby

539.152.2

6452. EXPERIMENTS ON SPIN TEMPERATURE.
A.Abragam and W.G.Proctor.
Phys. Rev., Vol. 106, No. 1, 160 (April 1, 1957).

Changes in polarization have been observed when the spin systems of two nuclear species (F and Li) contained in the same sample are "thermally mixed". The mixing is performed by taking the sample from a strong magnetic field into the earth's field and then returning it in a time short compared with the spin–lattice relaxation time. The results may be understood in terms of ordinary calorimetry by assigning to each system a specific heat proportional to $\gamma^2 I(I+1)$. It has also been found possible to "pump" a nuclear system with a long spin–lattice relaxation time into a polarized state by cooling at regular intervals by thermal contact with a system which has a shorter relaxation time. This experiment was performed with Cs and Cl. D.J.A.Prowse

539.152.2

6453. POLARIZATION OF NUCLEI BY RESONANCE SATURATION IN PARAMAGNETIC CRYSTALS. C.D.Jeffries.
Phys. Rev., Vol. 106, No. 1, 164-5 (April 1, 1957)

Explains that with I—S coupling in electron resonance $\Delta(m + M) = 0$ transitions, though weak, become permitted with the r.f. field parallel to the static field. Saturation of these transitions leads to nuclear polarization which may be observed by the γ-ray anisotropy of radioactive nuclei. D.H.Whiffen

539.152.2

6454. γ-RAY ANISOTROPY OF Co^{60} NUCLEI POLARIZED BY PARAMAGNETIC RESONANCE SATURATION.
M.Abraham, R.W.Kedzie and C.D.Jeffries.
Phys. Rev., Vol. 106, No. 1, 165-6 (April 1, 1957).

The polarization of Co nuclei using paramagnetic resonance saturation is reported. Scintillation counters and a paramagnetic resonance apparatus operated at low temperatures was used. The paramagnetic resonance h.f.s. of Co^{59} was observed simultaneously with the γ-ray anisotropy of Co^{60}. The sign of the anisotropy agrees with calculation while its magnitude is about half that expected from complete saturation of the forbidden transitions. J.W.Sturgess

539.152.2

6455. A HIGH-RESOLUTION HERTZIAN SPECTROGRAPH AND NUCLEAR RELAXATION. C.Manus.
Arch. Sci. (Geneva), Vol. 9, No. 4, 345-436 (1956). In French.

A thesis-style account of a nuclear magnetic resonance spectrometer with chapters on history, theory of signal shape, the electronic circuits, the lock-in detector, magnetic field production, theory and observation of side bands related to the modulation frequency. D.H.Whiffen

539.152.2

6456. HIGH STABILITY NUCLEAR MAGNETIC RESONANCE SPECTROGRAPH. E.B.Baker and L.W.Burd.
Rev. sci. Instrum., Vol. 28, No. 5, 313-21 (May, 1957).

An n.m.r. spectrograph using an electromagnet is superstabilized by a feedback loop which uses the error signal from a secondary nuclear resonance probe to control the oscillator driving frequency. Field fluctuations thus produce such frequency variations as to preserve the Larmor condition for both short and very long times. The same oscillator is used for the measurement probe and thus also the Larmor condition is preserved in the sample being measured. Means are provided for sweeping frequency to produce precalibrated spectra of high precision at various magnifications and scale shifts with a very convenient and rapid set-up procedure. Frequency scales are directly related to graph-paper markings. Improved temperature control of the magnet and a reproducible precycling recipe also contribute to an unusually high degree of stability and reliability of day-to-day operation. A.

539.152.2 : 536.58

6457. CRYOSTATS AND MECHANICAL STAGE FOR NUCLEAR MAGNETIC RESONANCE STUDIES. L.N.Mulay.
Rev. sci. Instrum., Vol. 28, No. 4, 279-82 (April, 1957).

Cryostats for use with liquid helium and other coolants providing temperatures in the range 77° to 600°K constant to within ±1 deg. are described. These are designed to provide a self-contained probe with the facility of interchanging different radiofrequency coils. The r.f. coil is so mounted that it keeps the sample free from condensation of moisture at low temperatures and facilitates changing of samples without disturbing its position in the homogeneous region of the magnetic field. A mechanical stage which locates this region and clamps the probe in this position is also described. It reproduces this setting quickly and is particularly useful for high resolution studies. A new method of setting up the mechanical stage with the cryostat, the magnet, and the oscillator provides a compact assembly with considerable ease in their operation and allows the use of a very short coaxial cable (about 6 in.) for connecting the r.f. coil to the oscillator. This considerably improves the signal-to-noise ratio. A.

539.152.2

6458. NUCLEAR MAGNETIC RESONANCE IN PARAMAGNETIC IRON GROUP FLUORIDES.
V.Jaccarino, R.G.Shulman and J.W.Stout.
Phys. Rev., Vol. 106, No. 3, 602 (May 1, 1957).

Measurements of the shifts of F-resonance in CoF_2, FeF_2, NiF_2, CrF_3, FeF_3 and CuF_2 as a function of temperature. The large shifts up to 8% arise from coupling with the unpaired electrons of the metal ion which are partly on the F-ions; this transference is analysed quantitatively. The anisotropy in single crystals of CoF_2 and FeF_2 was also measured. D.H.Whiffen

539.152.2

6459. NUCLEAR MAGNETIC RESONANCE IN CoF_2 AND FeF_2.
J.M.Baker and W.Hayes.
Phys. Rev., Vol. 106, No. 3, 603-4 (May 1, 1957).

Measurement of F-resonances as a function of field direction in single crystals of CoF_2 and FeF_2. The large shifts are compared with theory and approximate agreement obtained. D.H.Whiffen

539.152.2

6460. THE THEORY OF CHEMICAL SHIFTS IN NUCLEAR MAGNETIC RESONANCE. I. INDUCED CURRENT DENSITIES.
J.A.Pople.
Proc. Roy. Soc. A, Vol. 239, 541-9 (April 9, 1957).

The chemical shifts of nuclear magnetic resonance frequencies are determined by the secondary magnetic field due to the electronic current induced by the applied field. This paper is concerned with the general problem of finding the current density vector field. An approximate orbital theory is developed which enables this to be divided up, under certain conditions, into local diamagnetic and paramagnetic circulations about individual atoms. The method is applied to the acetylene molecule as an example. A.

539.152.2

6461. THE THEORY OF CHEMICAL SHIFTS IN NUCLEAR MAGNETIC RESONANCE. II. INTERPRETATION OF PROTON SHIFTS. J.A.Pople.
Proc. Roy. Soc. A, Vol. 239, 550-6 (April 9, 1957).

The interpretation of proton chemical shifts is discussed in terms of the magnetic field due to the types of electronic current discussed in Pt I. It is shown that local paramagnetic circulations on neighbouring atoms may have a considerable effect on the resonance frequency. The anomalous position of the acetylenic proton can be ascribed to this effect. For the series of molecules CH_4, NH_3, H_2O, HF, calculations show that there is an effect of paramagnetic currents around the central atom which increases along the series and which operates in the opposite direction to the electronegativity effect. It is suggested that the comparatively small change in the proton frequency along this series is due to cancellation of these terms. A.

539.152.2

6462. A QUANTITATIVE COMPARISON OF THE THEORY OF MAGNETIC RESONANCE OF ATOMIC NUCLEI WITH EXPERIMENT.
A.V.Kessenikh and N.M.Pomerantsev.
Vestnik Moskov. Univ., No. 3, 57-62 (1956). In Russian.

The experimental side consisted of determining the absorption curve of the magnetic resonance of protons in aqueous solutions of $Fe(NO_3)_3$ at various concentrations. The apparatus consisted essentially of a coil excited at 13 Mc/s situated in a magnetic field of 3000 gauss which was modulated sinusoidally at 50 c/s at amplitudes of 1-10 gauss. The specimen consisted of 0.7 cm^3 of solution in a glass ampoule and this was placed in the coil. By means of the Bloch equations, absorption curves for the specimens were also calculated. Agreement between experimental and theoretical curves was satisfactory. C.R.S.Manders

539.152.2

6463. THE INTENSITY OF MAGNETIC PROTON RESONANCE ABSORPTION AT THERMAL EQUILIBRIUM.
H.Greim and J.Richter.
Z. Phys., Vol. 147, No. 3, 317-22 (1957). In German.

Describes a n.m.r. spectrometer for absolute intensity measurements with ±10% accuracy. For H_2O at 1362 gauss, 5.8 Mc/s agreement with theory to within 4% was obtained. For unknown cases spin and magnetic moment could be evaluated from the frequency and intensity in a single experiment. D.H.Whiffen

539.153 : 537.228.5

6464. STARK EFFECT OF THE 6^3P_1 LEVEL OF THE MERCURY ATOM. J.E.Blamont and J.Brossel.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2038-40 (Dec. 17, 1956). In French.

Observations have been made for each of the isotopes: Hg^{199}, Hg^{201}. The magnetic resonance method (Abstr. 5993/1952) was employed, and a quadratic dependence upon electric field was confirmed. R.W.Nicholls

539.153

6465. ON THE MAGNETIC RESONANCE OF THE ATOMIC LEVELS OF MERCURY EXCITED BY ELECTRON BOMBARDMENT.
J.C.Perbay-Peyroula, J.Brossel and A.Kastler.
C.R. Acad. Sci. (Paris), Vol. 244, No. 1, 57-9 (Jan. 2, 1957).
In French.

The 6^3P_1 level of mercury was excited by 8 eV electrons in the

presence of r.f. and magnetic fields. The intensity difference between parallel and perpendicularly polarized components of the 2537 A line was observed as a function of magnetic field strength from which a lifetime ~ 10^{-7} sec for the 6^3P_1 level was obtained. Preliminary observations were made on other lines.

R.W.Nicholls

539.153 : 537.567

6466. ELECTRON AFFINITY OF ATOMIC SULFUR AND EMPIRICAL AFFINITIES OF THE LIGHT ELEMENTS.
L.M.Branscomb and S.J.Smith.
J. chem. Phys., Vol. 25, No. 3, 598-9 (Sept., 1956).

Measurements by the method of Abstr. 8166 (1955) give the electron affinity of S as 2.07 ± 0.07 eV. The experimental affinities of C, O, F, S and Cl are compared with the predictions of several empirical estimation methods. No method is in perfect agreement for relative affinities, but the quadratic extrapolation of isoelectronic excited states (Abstr. 7151/1955) appears most satisfactory.

J.Hawgood

539.153

6467. ATOMIC SCATTERING FACTORS CALCULATED FROM THE T.F.D. ATOMIC MODEL. L.H.Thomas and K.Umeda.
J. chem. Phys., Vol. 26, No. 2, 293-303 (Feb., 1957).

Using the T.F.D. electron density, the atomic scattering factor f_0 has been calculated for neutral atoms as well as for singly through quadruply ionized positive ions with intermediate atomic numbers on the I.B.M. 607 and 650. The f_0 values thus obtained for Ag and Cu^+ agree qualitatively with those calculated from the Hartree–Fock fields recently by MacGillavry et al. The experimental fact has been again confirmed, that the f_0 value is not much influenced by the state of ionization. The effect of exchange has been displayed by the deviation of the T.F.D. curve of the atomic scattering factor per electron f_0 v. the Bethe variable ξ, from the T.F. universal curve. The T.F.D. curve of f_0 v. Z for a definite state of ionization has a slight minimum at a certain value of Z which increases with decreasing scattering angle and tends finally at vanishing scattering angle to a definite limiting value just corresponding to the maximum of $\langle r^2 \rangle_{Av}$.

A.

539.153

6468. OPTICAL ORIENTATION OF CAESIUM ATOMS IN SATURATED VAPOUR. A.Blandin and J.P.Barrat.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2041-3 (Dec. 17, 1956).
In French.

The magnetic resonance spectrum of the $6^2S_{1/2}$ state of Cs has been observed by the optical orientation method (Abstr. 8171/1950). A constant radiofrequency of 28.436 Mc/s and a variable magnetic field of about 80 Oe were employed. Line profiles were measured from the difference in photocurrent from each of two cooled i.r. photomultipliers which respectively received oppositely circularly polarized resonance radiation. The following lines were observed: $-4 \leftrightarrow -2$, $-4 \leftrightarrow -1$, $-4 \leftrightarrow 0$, $-4 \leftrightarrow 1$; $-3 \leftrightarrow 1$, $-3 \leftrightarrow 2$; $-2 \leftrightarrow 2$, $-2 \leftrightarrow 3$; $-1 \leftrightarrow 3$, $-1 \leftrightarrow 4$; $0 \leftrightarrow 4$; $1 \leftrightarrow 4$.

R.W.Nicholls

539.153

6469. OPTICAL METHODS OF ATOMIC ORIENTATION AND OF MAGNETIC RESONANCE. A.Kastler.
J. Opt. Soc. Amer., Vol. 47, No. 6, 460-5 (June, 1957).

In the optical excitation of atoms with polarized light, producing excited atoms, only some of the Zeeman sublevels of the excited state are actually reached, so that large differences of population can be built up between Zeeman sublevels or between hyperfine structure (h.f.s.) levels. This property can be used to detect radiofrequency resonance in optically excited atomic states. These resonances produce a characteristic change in intensity or in the degree of polarization of the light re-emitted. Zeeman intervals, Stark effects, and h.f.s. intervals can be measured in this manner. (The Stark constant of 6^3P_1 level of Hg and the electric quadrupole moments of the alkali atoms have been obtained in this way). The technique of "optical pumping" gives a way to concentrate atoms in some of the Zeeman sublevels of one of the h.f.s. levels of the ground state. Atomic orientation has been obtained with the Na atom, in an atomic beam and in the vapour in equilibrium with the metal. The orientation effects have been studied by detection of radiofrequency resonance signals in the ground state. Orientation can be increased many times by adding a variable pressure of a foreign gas to the pure Na vapour. Because of the coupling between nuclear spin and electron spin, nuclear orientation is produced at the same time as atomic orientation.

A.

539.153

6470. SLOW SPIN RELAXATION OF OPTICALLY POLARIZED SODIUM ATOMS. H.G.Dehmelt.
Phys. Rev., Vol. 105, No. 5, 1487-9 (March 1, 1957).

In order to obtain as narrow as possible paramagnetic resonance signals, it is of importance to investigate the conditions under which long relaxation times can be realized. In the present experiment on sodium atoms diffusing in argon gas, relaxation due to sodium–sodium collisions was minimized by employing very low sodium partial vapour pressured (about 10^{-7} mm Hg). While at lower pressures the argon is serving its function well to slow down relaxation by inhibiting wall diffusion, at about 10 cm Hg relaxation due to sodium–argon collisions becomes the decisive factor. Nevertheless it was possible to realize a relaxation time of 0.21 sec for a litre spherical bulb filled with 3 cm argon. About 0.02 sec was found for a 0.1 litre, 40 cm argon sample. In carrying out the experiments, optical pumping by circularly polarized resonance radiation was used to create an orientation of the sodium atoms which then was monitored by measuring the transmission of the pumping radiation through the sample. By suddenly reversing a small axial magnetic field, the polarization of the atoms could be made to reverse too. From the decay rates of this inverted polarization under the combined effects of relaxation and continuing optical pumping, the experimental relaxation times were deduced. The strong signals obtained are indicative of available signal to noise ratios in future radiofrequency resonance reorientation experiments using the transmission monitoring technique. A theoretical analysis of the optical pumping process, including the dynamic aspects and allowing for collisions with argon that the sodium atoms undergo while in the excited state, was carried out and used to describe the experimental data.

A.

539.153

6471. HYPEPFINE STRUCTURE OF TRITIUM IN THE GROUND STATE. A.G.Prodell and P.Kusch.
Phys. Rev., Vol. 106, No. 1, 87-9 (April 1, 1957).

The hyperfine splitting of tritium in the $1\ ^2S_{1/2}$ state has been measured by the atomic beam method. It is found that $\Delta\nu(T) = 1516.70170(7) \times 10^6\ sec^{-1}$, where the number in parentheses indicates the uncertainty in the last quoted figure. Within the precision of the presently available value of the ratio of the magnetic moment of the triton and the proton, there is no experimental evidence of a hyperfine structure anomaly between tritium and hydrogen.

A.

539.153 : 535.43

LIFETIME OF THE 6^3P_1 LEVEL OF THE MERCURY ATOM.
See Abstr. 6071

539.153.1

6472. THE PROTON DENSITY CALCULATED ON THE BASIS OF THE STATISTICAL MODEL OF THE NUCLEUS.
I. CALCULATION OF THE ENERGY LEVELS OF MESONIC ATOMS.
D.Kisdi.
Acta phys. Hungar., Vol. 6, No. 3-4, 443-54 (1957). In German.

The excitation energies for the 1s–2p transitions have been computed using the statistical model of the nucleus. Calculations were done for Ti, Cu, Sb and Pb and gave values of 0.842, 1.43, 3.90 and 7.75 MeV compared with experimental values of 0.955, 1.55, 3.50 and 6.02 MeV. Discussions of the best nuclear radius to be taken and of the expected nuclear proton density are given.

D.J.A.Prowse

539.153.1 : 537.531

6473. PRECISION MEASUREMENT OF X-RAY FINE STRUCTURE EFFECTS OF NUCLEAR SIZE AND QUANTUM ELECTRODYNAMICS. R.L.Shacklett and J.W.M.DeMond.
Phys. Rev., Vol. 106, No. 3, 501-12 (May 1, 1957).

Schawlow and Townes have made a theoretical calculation of the perturbing effect of the finite size of the nucleus on the L_{II}-L_{III} X-ray doublet splitting in heavy elements. Combined with approximate calculations by Christy and Keller of the unperturbed splitting for the case of a point nucleus, comparison of this theory with such experimental values of the splitting as were then available led to an anomalously large value of nuclear radius, $R = r_0A^{1/3}$ with $r_0 = 2.1 \times 10^{-13}$ cm. Schawlow and Townes offered the suggestion to account for this that quantum electrodynamic effects probably modify the fine structure in much the same way as an oversize nucleus. The present investigation was undertaken to improve on the precision of the X-ray measurements yielding the L_{II}-L_{III} fine structure splitting and to incorporate into a new comparison between theory and experiment the recent vacuum polarization correction of

Wichmann and Kroll. The measurements of the L_{II}-L_{III} splitting for W, Pt, Bi, Th, U, and Pu are based on two-crystal spectrometer determinations of the Bragg angles of the $L\alpha_2$ and $L\beta_1$ X-ray lines of these elements. Techniques of measurement and corrections for vertical divergence and crystal diffraction pattern asymmetry leading to a relative precision (relative standard deviation) in the splitting of about 50 parts per million are described. A comparison is made with the data used by Schawlow and Townes, and a discrepancy is found in several earlier wavelength values which may account partly for the large value of r_0 obtained by them. A comparison of the theoretical to the present experimental values of the splitting, assuming no quantum electrodynamic effects, yields a value of $r_0 = 1.08 \times 10^{-13}$ cm. When corrections are made for vacuum polarization and a nuclear radius of $r_0 = 1.2 \times 10^{-13}$ cm, a comparison with experiment shows that a discrepancy remains which is then used to evaluate an empirical correction term. The sign, magnitude, and Z dependence of this term suggest that the remaining discrepancy might arise principally from the Lamb shift effect. A.

539.153.4

6474. THE INHOMOGENEITY CORRECTION OF THE FERMI KINETIC ENERGY OF PARTICLES WITH HALF INTEGRAL SPIN. P.Szépfalusy.
Acta. phys. Hungar., Vol. 6, No. 2, 293-305 (1956). In German.

It is shown that the correction, due to Weizsäcker and Gombas, in the energy of the Thomas–Fermi statistical atom can be derived by using the Hartree–Fock model. P.M.Davidson

539.153.4

6475. TWENTY-PARAMETER EIGENFUNCTIONS AND ENERGY VALUES OF THE GROUND STATES OF He AND He-LIKE IONS. J.F.Hart and G.Herzberg.
Phys. Rev., Vol. 106, No. 1, 79-82 (April 1, 1957).

The nonrelativistic energies of the ground states of H^-, He, Li^+, B^{+++}, O^{6+}, Ne^{8+}, Mg^{10+} have been calculated by using 20-parameter Hylleraas functions. The coefficients of these functions are listed. The correction due to the motion of the nucleus (mass polarization correction) has been calculated on the basis of these 20-parameter functions. Except for He this correction is found to be quite different from earlier values in the literature. The present status of the problem of the Lamb shift of the ground state of He is briefly discussed. A.

539.153.4

6476. DOUBLE RESONANCE MEASUREMENTS OF HYPERFINE STRUCTURES IN POTASSIUM. G.J.Ritter and G.W.Series.
Proc. Roy. Soc. A, Vol. 239, 473-88 (Jan. 29, 1957).

Radio-frequency magnetic resonances have been studied between the states of the atomic level $5\ ^2P_{3/2}$, excited in a coarse atomic beam of potassium by optical resonance radiation. The resonances were detected by observing changes in the intensity of the scattered resonance radiation. Hyperfine structure was observed in the Paschen–Back region, and in magnetic fields down to zero. Values of a and b, the magnetic dipole and electric quadrupole interaction constants, derived independently from measurements in the strong and zero field regions, are in agreement. The values $a = 1.97 \pm 0.1$ Mc/s, $b = 1.7 \pm 0.3$ Mc/s have been obtained for the interaction constants of K^{39}. Double quantum transitions between hyperfine structure levels were observed in zero field. The nuclear magnetic moment derived from a agrees with molecular beam magnetic resonance measurements; the nuclear electric quadrupole moment derived from b is $0.11_3 \pm 0.02 \times 10^{-24}$ cm^2. Hyperfine structure was also observed in the level $5\ ^2P_{1/2}$. A preliminary value for the a factor is 9.3 ± 0.5 Mc/s. A.

539.153.4

6477. THE LIMITING BEHAVIOUR OF ATOMIC WAVE FUNCTIONS FOR LARGE ATOMIC NUMBER. C.Froese.
Proc. Roy. Soc. A, Vol. 239, 311-19 (March 12, 1957).

If P(nl; r) is the (nl) radial wave-function in an atom of atomic number N, and P_H(nl; r) is the corresponding wave-function of hydrogen, then, for a given configuration and for large N

$$N^{-1/2}P(nl; r) = P_H(nl; Nr) + (1/N)\,Q(nl; Nr) + O(1/N^2).$$

The equations for the functions Q(nl; Nr) have been set up and solved for a number of (nl) values and configurations of up to twenty-eight electrons. From the solutions, the limiting values as $N \to \infty$ of certain screening numbers σ(nl) have been determined, so that estimation of σ(nl) for atoms of atomic number higher than any for which calculation of wave-functions has been carried out becomes a process of interpolation instead of extrapolation. It is found that for given configuration σ(nl) is nearly linear in the mean radius $\bar{r}$ over the whole range from $N \to \infty$ to the neutral atom. For a given value of $r/\bar{r}$(nl), $\bar{r}^{1/2}P_N(nl; r)$ is nearly linear in $\bar{r}$. The $\bar{r}$ derivatives of this function at $\bar{r} = 0$ can also be evaluated from the Q(nl; Nr) functions. A.

539.153.4

6478. LEVEL SHIFTS IN HELIUM.TRIPLE FORCES. G.Filimonov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 311-15 (1957). In Russian.

A fourth-order expression for the Hamiltonian of interaction of two fields has been obtained which contains triple forces. An expression for the matrix element of the energy of triple collisions between two electrons and an α-particle has been obtained and computations have been performed for the 1^1S state of helium. The shift determined in this way is found equal to (1.02 ± 0.15)cm^{-1} and does not remove the discrepancy between theory and experiment. Some effects are discussed which might be invoked to bring the theory into agreement with experiment. A.

539.155.2

6479. FIRST EXPERIMENT ON DOUBLE MONOCHROMATION IN ELECTROMAGNETIC SEPARATION OF ISOTOPES. C.Cassignol.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 113A-115A (Nov., 1956). In French.

Causes limiting enrichment in e.m. separators are enumerated, and the electrostatic system at Saclay described. In the first section, the whole beam is received on a plate carrying a slit onto which the image of the slit-source for a particular isotope is focused. The beam passes into the second analyser where it is refocused, the other isotopes being stopped or collected in the usual way. Preliminary experimental results on U^{235} enrichment are reported: A 300 μA beam from a source of natural uranium, (7% U^{235}), running for a few hours yielded a fraction of a milligram, with 79% U^{235}; the enrichment coefficient was over 500. Running without the post-analyser, 11.5% U^{235} was recovered, enrichment being about 19. N.M.King

539.155.2 : 541.135

6480. INFLUENCE OF OXYGEN ON THE ELECTROLYTIC SEPARATION OF HYDROGEN ISOTOPES. J.Brun and K.Andreassen.
K. Norske Vidensk. Selsk. Forhandl., Vol. 28, No. 1, 1-4 (1955).

Aqueous 5% KOH containing 10% D_2O was electrolysed at an average cathodic current density of 0.05 A/cm^2. Cathodes of mild steel, nickel and copper and an anode of nickel were used. It was found that oxygen had a favourable effect on the isotopic H/D separation efficiency without having a depolarizing effect on the cathode potential. W.Good

539.155.2 : 541.147

6481. NOTE ON THE ISOTOPIC EFFECT IN THE FRACTIONAL DECOMPOSITION OF POTASSIUM FLUOBORATE. M.D'Hont and A.de Lattre.
Nuclear Physics, Vol. 2, No. 6, 736 (Feb., 1957).

It has been established by Shyuttse (Abstr. 7638/1956) that in the thermal decomposition of KBF_4 the first fractions of BF_3 are enriched in the heavy isotope B^{11}. The authors show that the effect reported by Shyuttse appears to be in conformity with theoretical predictions if rapid exchange between boron trifluoride and the fluoborate from which it originates is assumed. The deviation of the equilibrium constant K from unity is practically entirely due to the zero-point energy effect. A.

539.155.2 : 523.51

ABUNDANCES OF METEORIC LEAD ISOTOPES. See Abstr. 5808

539.155.2 : 536.421.4

EQUILIBRIUM DISTRIBUTION OF LIGHT AND HEAVY WATERS IN A FREEZING MIXTURE. See Abstr. 6108

RADIOACTIVITY. α-, β- AND γ-RAYS

539.16

539.16.08

6482. ON THE CHOICE OF RESOLVING TIME AND SOURCE STRENGTH IN COINCIDENCE EXPERIMENTS. P.Weinzierl.
Acta phys. Austriaca, Vol. 10, No. 3, 190-7 (1956). In German.

A treatment is given of the effect of spurious coincidences on

the statistics of coincidence measurements. From this an estimate is obtained of the optimum source strength, and this is inversely proportional to the coincidence resolving time. However, if the fluctuations associated with the emission and collection of scintillation impulses are taken into account, an optimum resolving time is obtained. The main methods of attaining short resolving times with simultaneous impulse size discrimination are discussed.

B.T.M.Willis

539.16.08

6483. ABSOLUTE ALPHA-COUNTING OF ASTATINE-211. J.K.Basson.
Analyt. Chem., Vol. 28, No. 9, 1472-4 (Aug., 1956).

At^{211}, used in thyroid physiology, has a half-life of 7.3 hr and each disintegration yields (besides 80 kV X-rays) one alpha-particle of either 5.89 or 7.43 MeV. Alpha-radiation was measured by placing a small cylindrical vessel containing the phosphor (terphenyl) dissolved in p-dioxan and the specimen on top of a photomultiplier tube. A semi-spherical reflector covered the vessel. P-dioxan was used because it readily mixes with water and the astatine is usually in aqueous solution. The photomultiplier tube was connected to a conventional scaling unit. A grey-wedge spectrum of the impulses shows clearly the two alpha-peaks as well as a peak from the 80 kV X-rays. V.Quittner

539.16.08

6484. DETERMINATION OF ACTINIUM BY DIRECT MEASUREMENT [OF RADIOACTIVITY] IN SOLUTION. M.Perey.
C.R. Acad. Sci. (Paris), Vol. 243, No. 19, 1411-14 (Nov. 5, 1956). In French.

The method uses a G.M. bell-counter; the sensitivity is about 0.003 μC Ac in 2.5 g solution. A.O.Stanesby

539.16.08

6485. ASSAY OF ELECTRON-CAPTURE NUCLIDES WITH A PROPORTIONAL COUNTER SPECTROMETER.
W.S.Lyon and S.A.Reynolds.
Internat. J. appl. Radiation and Isotopes, Vol. 2, No. 1, 80-4 (April, 1957).

An end-window-type proportional counter has been employed, which is suitable for assay of the disintegration rate of electron-capture nuclides. The use of this counter with a differential and integral pulse-height selector for absolute measurement of disintegration rate is described. Methods of determining the absolute efficiency of the system at different X-ray energies, by coincidence techniques and measurements in a high-pressure ionization chamber, are outlined. A comparison of the results obtained with those of other workers is given. A.

539.16.08

6486. COMPARISONS OF NATIONAL RADIUM STANDARDS.
T.P.Loftus, W.B.Mann, L.F.Paolella, L.L.Stockmann and W.J.Youden.
J. Res. Nat. Bur. Stand., Vol. 58, No. 4, 169-74 (April, 1957).

The national primary radium standards of the Federal Republic of Germany and the Dominion of Canada have recently been compared with the two United States national primary radium standards at the National Bureau of Standards. The comparisons were made using the standard electroscope and radiation balance, and the results obtained for these four Hönigschmid standards have been compared with those obtained in an earlier comparison of the United States primary radium standards with that of the United Kingdom, which is also a Hönigschmid standard. In every case, agreement with Hönigschmid's values to within 0.2% has been obtained. A.

539.16.08

6487. DISASTER MONITORING WITH AMATEUR PHOTOGRAPHIC FILM AND DENTAL X-RAY FILM. M.Ehrlich.
Radiology, Vol. 68, No. 2, 251-4 (Feb., 1957).

Various types of photographic films available commercially to amateur photographers and for radiological purposes to dentists have been tested to see whether they can be usefully used in the monitoring of radiation in an atomic explosion. The results of laboratory tests and of field exposures to the prompt radiation from the detonation of an atomic bomb show that most films are satisfactory for relative intensity determinations provided the development conditions are controlled. D.J.A.Prowse

539.16.08 : 537.542

RADIOCARBON DATING. See Abstr. 6293

539.16.08 : 537.542

C^{14} CONTENT MEASUREMENT. See Abstr. 6297

539.16.08 : 537.542

ANALYSIS OF LOW LEVELS OF RADON. See Abstr. 6298

539.16.081 : 614.898 : 615.849

6488. REPORT OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS AND MEASUREMENTS (ICRU) 1956.
Handb. Nat. Bur. Stand., No. 62, 48 pp. (1956).

This report on the I.C.R.U. supersedes the material previously published in National Bureau of Standards Handbook 47 (Abstr. 9877/1951), and was prepared as a result of the Commission's meetings in Geneva in April 1956. In addition to new recommendations regarding radiological units, the report includes an extensive description of the physical background and factors that enter into the problems of the measurement of absorbed dose of all kinds of radiation. It also includes reports of two Subcommitees of the I.C.R.U. namely, Subcommitee on X-ray Standards and Subcommitee on Standards of Radioactivity. A.

539.163

6489. STUDY OF A POSSIBLE CONTAMINATION BY Al OF Po SOURCES AND OF THEIR SUPPORTS AND SCREENS.
M.Ader and M.P.Cabannes.
J. Phys. Radium, Vol. 18, No. 1, 44-6 (Jan., 1957). In French.

The null result of a search for protons from the (α,p) reaction on Al showed that the long-range particles found near Po sources are not due to this transmutation. A.O.Stanesby

539.163

6490. STUDY OF RaD SOURCES USING ILFORD E_1 EMULSIONS.
M.Ader and M.P.Cabannes.
J. Phys. Radium., Vol. 17, No. 12, 1023-4 (Dec., 1956). In French.

539.163

6491. PRODUCTION AND PROPERTIES OF THE NUCLIDES FERMIUM-250, 251 AND 252. S.Amiel, A.Chetham-Strode, Jr, G.R.Choppin, A.Ghiorso, B.G.Harvey, L.W.Holm and S.G.Thompson.
Phys. Rev., Vol. 106, No. 3, 553-4 (May 1, 1957).

The nuclides Fm^{250}, Fm^{251}, and Fm^{252} were produced by alpha-bombardment of Cf^{249}. The excitation functions for their formation, as well as some of their nuclear properties, were measured. A.

539.163

6492. THE ISOMER Pb^{204m}.
C.J.Herrlander, R.Stockendal, J.A.McDonell and I.Bergström.
Nuclear Physics, Vol. 1, No. 9, 643-56 (Aug., 1956).

The conversion lines following the decay of Pb^{204m} have been studied in a double-focusing β-spectrometer and a semicircular permanent magnet β-spectrometer. The half-life of the isomer has been remeasured, and the value 67.5 ± 0.5 min obtained. The energies of the previously known gamma-transitions have been reinvestigated and are 911.7 ± 0.3, 374.7 ± 0.4 and 899.3 ± 0.3 keV. The maximum amounts of M6 and M3 admixtures in the 911.7 keV E5 and 374.7 keV E2 transitions are both found to be 0.5%. Two new weak gamma-rays have been found with energies 289.4 ± 0.2 and 622.2 ± 0.2 keV, the latter being an E5 transition emitted from the isomeric 9 − level to a new 4+ level. These experiments unambiguously suggest the following level sequence: 0 (0+), 899.3 (2+), 1274.0 (4+), 1563.4 (4+) and 2185.7 (9−) keV. The experimental level scheme is compared with the theoretical predictions by W.W.True. A.

539.163.1

6493. HALF-LIVES OF THE EXCITED STATES OF Eu^{153}.
M.Vergnes and N.Marty.
J. Phys. Radium, Vol. 17, No. 10, 908-9 (Oct., 1956). In French.

These were determined using fast delayed-coincidence techniques; for the 103 keV level, $T_{1/2} = (4 \pm 0.2) \times 10^{-9}$ sec, and for the 98 and 172 keV levels, $T_{1/2} < 10^{-9}$ sec. A.O.Stanesby

539.163.1

6494. LIFETIME MEASUREMENT BY TIME TO PULSE HEIGHT CONVERSION, APPLIED TO THE 517 keV LEVEL OF ^{85}Rb.
J.G.Siekman.
Nuclear Physics, Vol. 2, No. 3, 254-8 (Nov., 1956).

A simple method based on time to pulse height conversion, which can be used for time delay measurements in the microsecond region has been developed. Using this method the lifetime of the $g_{9/2}$ level of Rb^{85} occurring in the Kr^{85} decay proved to be $(9.0 \pm 0.4) \times 10^{-7}$ sec which is in good agreement with earlier measurements, and proves the identity of the γ-transitions of about 515 keV occurring in the decay of Kr^{85} and Sr^{85}. A.

539.163.2

6495. ON THE DISINTEGRATION OF W^{185}.
N.Marty and M.Vergnes.
J. Phys. Radium, Vol. 17, No. 11, 1013-15 (Dec., 1956). In French.

W^{185} emits a simple β-spectrum with $E_{max} = 425 \pm 2$ keV; the 57 keV line is the X-radiation of Ta, presumably due to K-capture in W^{181}. The continuous γ-background with a max. intensity at about 120 keV is attributed to bremsstrahlung. A.O.Stanesby

539.163.2

6496. DECAY SCHEME FOR Zr^{97} AND Nb^{97}.
N.N.Delyagin, A.A.Sorokin, N.V.Forafontov and V.S.Shpinel.
Nuclear Physics, Vol. 2, No. 6, 687-705 (Feb., 1957).

The decay scheme has been investigated with a double-lens β-spectrometer connected in coincidence with a scintillation γ-spectrometer and also with a coincidence scintillation γ-spectrometer. A partial β-spectrum has been separated which has an upper limit $E_\beta = 0.45$ MeV and can be assigned to Zr^{97}. In addition to known intense γ-lines from Zr^{97}, weak γ-lines — 1.35 (3-5%); 1.62 ($\cong$ 1.5%); 2.2 (1-2%); 2.58 ($\leq$ 1%) MeV — have been detected. The existence of cascade γ-radiation has been established and a tentative decay scheme is proposed. A.

539.163.2

6497. DECAY OF Hf^{181}. E.S.Snyder and S.Frankel.
Phys. Rev., Vol. 106, No. 4, 755-64 (May 15, 1957).

The decay of Hf^{181} to Ta^{181} was studied by angular correlation measurements (133 K—482 γ, 133 γ—482 γ, and 133 γ—482 K, energies being given in keV), conversion coefficient measurements [$\alpha_K(133) = 0.50 \pm 0.06$, $\alpha_K(136) = 1.2 \pm 0.2$, $\alpha_K(346) = 0.038 \pm 0.007$, $\alpha_K(482) = 0.023 \pm 0.002$], K/L ratios, and coincidence measurements. The weak 137 keV transition, first observed by Mihelich, was placed in the decay by delayed coincidence measurements. The spin assignments are in excellent agreement with the calculations of Nilsson on the strong-coupling model. Comparison of K—γ and γ—γ correlation coefficients in the HfO_2 sources fails to show any after effects of K-hole formation on the correlation coefficients. The discrepancy between the E2/M1 ratio obtained from γ—γ correlation measurements in the 482 keV transition is discussed in terms of the improved finite nuclear size corrections to M1-conversion coefficients described by Church and Weneser. A.

539.163.2

6498. RADIATIONS FROM W^{185} AND W^{187}.
V.S.Dubey, C.E.Mandeville, A.Mukerji and V.R.Potnis.
Phys. Rev., Vol. 106, No. 4, 785-90 (May 15, 1957).

The radiations of W^{185} and W^{187} have been examined in a thin-lens magnetic spectrometer, by coincident scintillation spectrometers, and with a gray-wedge analyser. W^{185} was found to emit no detectable gamma-rays. Its beta-spectrum is first-forbidden ($\Delta I = 1$, yes') and of maximum energy 440 ± 5 keV. By observation of internal conversion lines and photoelectric peaks, fourteen gamma-rays have been resolved in the decay of W^{187}. Three beta-ray spectra are emitted with end-point energies of 340 ± 20, 630 ± 10, and 1325 ± 15 keV with relative intensities of 10%, 70%, and 20%. The most energetic spectrum has the unique shape associated with a spin change of two and a change of parity. A.

539.164.2

6499. ALPHA DECAY OF DEFORMED NUCLEI. P.O.Fröman.
K. Danske. Vidensk. Selsk. mat.-fys. Skr., Vol. 1, Paper 3, 76 pp. (1957).

The problem of the alpha fine-structure intensities for deformed nuclei is treated on the basis of the unified nuclear model. A system of coupled differential equations for the radial wave-functions is obtained they correspond to the different channels into which the alpha-particle is able to leak out, leaving the daughter nucleus in different final states. An approximate analytical formula is derived for the intensities of the different alpha-groups in terms of the alpha wave-function on the nuclear surface. Also an analysis of the empirical data is presented. The nuclear deformation causes the alpha decay-rate to be enhanced by a factor which increases slowly with the nuclear deformation and which may amount to about 2 for the largest deformations actually found. However, an enhancement factor of this kind is difficult to detect experimentally. The empirical intensities of the even-parity alpha-groups of even-even nuclei indicate the existence of higher multipole deformations of even parity in the nuclear surface. The magnitudes of these higher-order deformations may change rapidly with the atomic number Z. From the empirical intensities of the odd-parity alpha-groups which have been found in some even-even nuclei, an estimate is presented of the magnitude of the nuclear octupole moment, the existence of which has been suggested by Christy to explain the presence of the odd-parity alpha-groups for these even-even nuclei. The favoured alpha-decays of odd-A nuclei and even-even nuclei are similar, and it is possible to obtain an approximate formula which relates the intensities of the favoured alpha-groups of an odd-A nucleus to the intensities of the alpha-groups of neighbouring even-even nuclei. This intensity formula which was first given in a recent paper by Bohr, Fröman, and Mottelson is discussed in greater detail. The angular distribution of alpha-particles from polarized nuclei are also considered. A.

539.165

6500. K-CAPTURE WITH TWO BREMSSTRAHLUNG QUANTA.
W.Menhardt.
Acta phys. Austriaca, Vol. 11, No. 1, 101-6 (1957). In German.

The dependence of the probability of allowed transitions on the angle between the quanta has been calculated for mixed coupling. Unfortunately the effect is much too small for experiments to yield useful information on the ratio of the coupling constants at the present time. W.A.Hepner

539.165

6501. L-ELECTRON CAPTURE IN THE DISINTEGRATION OF COBALT 57. A.Moussa and A.Juillard.
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1515-17 (Nov. 12, 1956). In French.

The ratio [K Auger electrons]/[conversion electrons] of a strongly converted γ-ray (14 keV) was measured directly using a magnetic spectrometer; the ratio of L/K captures was calculated as $\lambda_L/\lambda_K = 0.20 \pm 0.13$. A.O.Stanesby

539.165

6502. DETERMINATION OF THE K/β^- RATIO. A.A.Bashilov.
Nuclear Physics, Vol. 1, No. 9, 629-42 (Aug., 1956).

A method for determining the relative probabilities of two competing types of radioactive decay — K-capture and β^--decay — is described. The method is based on a magnetic spectrometer investigation of the photoelectrons ejected by X-rays emitted as a result of K-capture and conversion of β^--decay γ-rays. The magnetic spectrometer ("coetron") and auxiliary experiments on photoelectrons ejected by X-rays emitted by various radioactive sources are described. Results of measurements are presented for Au^{198}: $K/\beta^- < 10^{-4}$, for Ir^{192}: $K/\beta^- = (4.5 \pm 1.0) \times 10^{-2}$. A.

539.165 : 539.166

6503. INTERPRETATION OF THE EXPERIMENTAL RESULTS OF ANGULAR CORRELATION. P.C.Macq and M.de Hemptinne.
Nuclear Physics, Vol. 2, No. 2, 160-8 (Oct., 1956). In French.

Fuchs' theory of angular correlation for the β—γ cascade of type $2^- \rightarrow 2^+ \rightarrow 0^+$ is generalized and applied to the discussion of the experimental results for Rb^{86} and Cl^{36}. A.

539.165

6504. PARITY AND THE POLARIZATION OF ELECTRONS FROM Co^{60}. H.Frauenfelder, R.Bobone, E.von Goeler, N.Levine, H.R.Lewis, R.N.Peacock, A.Rossi and G.De Pasquali.
Phys. Rev., Vol. 106, No. 2, 386 (April 15, 1957).

If parity is not conserved, the emitted electrons should be longitudinally polarized, and theory suggests that the degree of polarization should be (v/c). Experiments here described verify the existence of the polarization, and are compatible with the predicted value. P.M.Davidson

539.165

6505. THE THEORY OF RADIATIVE K-CAPTURE. I.
J.Yukawa.
Progr. theor. Phys., Vol. 15, No. 6, 561-73 (June, 1956).

The bremsstrahlung spectra accompanying K-electron capture are calculated for allowed transitions as well as first and second forbidden transitions, including the effect of nuclear Coulomb field. The calculations are done with the second-order perturbation method. Capture interactions are adopted of the scalar, vector, tensor, axial vector and pseudoscalar forms. The plane-wave approximation used in the previous calculations is improved by the correct Coulomb wave-function. A.

539.165.08

6506. NEW SOURCE TECHNIQUE FOR BETA-RAY PERMANENT MAGNET SPECTROGRAPHS. F.P.Cranston, Jr. and W.J.McCreary.
Rev. sci. Instrum., Vol. 27, No. 11, 973 (Nov., 1956).

Electrophoretic deposition of the source on a fine wire has proved to be a satisfactory method which eliminates many of the difficulties inherent in the vacuum evaporation or dusting techniques. L.Pincherle

539.165.2

6507. EFFECT OF DISTRIBUTION OF NUCLEAR CHARGE ON ANGULAR CORRELATION IN BETA-DECAY.
A.Z.Dolginov and I.N.Toptigin.
Nuclear Physics, Vol. 2, No. 2, 147-59 (Oct., 1956).

The $\beta-\nu$ and $\beta-\gamma$ angular correlation has been computed with consideration of finite electron wavelength for the cases of uniform volume and surface nuclear charge distributions. The calculations were carried out for linear combinations of various forms of beta-decay interactions. It is shown that for transitions of first degree of forbiddenness the calculations yield results which perceptibly differ from those of existing approximate calculations. In some cases the difference was as high as 50%. The problem of choosing a nucleus which is most suitable for $\beta-\gamma$ angular correlation studies is discussed. A comparison of the theory with experiment is made for the Tm^{170} nucleus. A.

539.165.2 : 530.145

6508. POSSIBLE TESTS OF TIME REVERSAL INVARIANCE IN BETA DECAY. J.D.Jackson, S.B.Treiman and H.W.Wyld, Jr.
Phys. Rev., Vol. 106, No. 3, 517-21 (May 1, 1957).

Noninvariance under space reflection and charge conjugation has now been established for beta-decay processes. Invariance under time reversal remains an open question, however. Several possible tests for the validity of this symmetry operation are discussed. General expressions are given for the distribution function in three experimental situations, which have the possibility of detecting terms in allowed beta-decay that are not invariant under time reversal: (a) experiments in which the nuclei are oriented and electron and neutrino momenta are measured; (b) experiments in which the nuclei are not oriented, but the recoil momentum and electron momentum and polarization are observed; (c) experiments in which the nuclei are oriented and the electron momentum and polarization are measured. The distribution functions obtained omit Coulomb distortion effects and relativistic corrections for the nucleons, but are otherwise complete. Such experiments should permit, in addition to the detection of terms which are not invariant under time reversal, the beginnings of a determination of the ten complex coupling constants which now characterize beta-decay. An additional, somewhat surprising, result is found. If the two-component neutrino theory of Lee and Yang is correct, and if certain perhaps reasonable assumptions concerning the relative magnitudes of the various coupling constants are valid, then the longitudinal polarization of electrons in allowed beta-decay even from unoriented nuclei should be almost complete (specifically, equal to v/c). A.

539.166

6509. RADIATIONS FROM TWO RADIOACTIVE ISOTOPES OF GOLD. V.R.Potnis.
Indian J. Phys., Vol. 30, No. 8, 375-83 (Aug., 1956).

The angular correlation function of the 330-358 keV cascade in the decay of Au^{196} has been measured and is in accord with a 2-2-0 sequence of spins for the low lying states of Pt^{196}. The extent of anisotropy at 180° suggests the first emitted gamma transition to be a mixture of E2 in M1. The gamma radiation of the 185 day Au^{195} has been examined by scintillation counting methods and is found to consist of quanta at 31 keV and 99 keV in coincidence and the associated cross-over transition at 130 keV. A.

539.166

6510. THE GAMMA SPECTRUM OF Sb^{124}. B.S.Dzhelepov, N.N.Zhukovsky, V.G.Nedovesov, I.F.Uchevatkin and V.G.Chumin.
Nuclear Physics, Vol. 2, No. 4, 408-19 (Dec., 1956).

A new determination of the gamma spectrum of Sb^{124} is described. The results, including the relative intensities of the lines, are summarized. A.

539.166

6511. GAMMA RAYS FROM THE PROTON BOMBARDMENT OF N^{15}. S.Bashkin and R.R.Carlson.
Phys. Rev., Vol. 106, No. 2, 261-6 (April 15, 1957).

The yield of 4.43 MeV gamma-rays from the reaction $N^{15}(p,\alpha\gamma)C^{12}$ has been measured for proton energies between 800 keV and 4020 keV. A gas target, enriched to 61% in N^{15}, was used. New resonances were observed at bombarding energies of 1985 ± 20 keV, 3000 ± 30 keV, 3300 ± 35 keV, 3350 ± 50 keV, and 3520 ± 40 keV, with widths of 25 ± 5 keV, 45 ± 10 keV, 75 ± 15 keV, 750 ± 100 keV, and 100 ± 25 keV, respectively. The width of the previously known resonance at 1650 ± 15 keV was measured to be 65 ± 10 keV. Angular distributions for the 4.43 MeV gamma-rays were measured at eight energies, included all the observed resonances. Spin and parity assignments are made to the resonant states. The $N^{15}(p,\gamma)O^{16}$ yield was measured for proton energies between 850 keV and 3300 keV, but no new resonances were seen. The width of the known 1050 keV resonance was measured to be 125 ± 25 keV. A

539.16

6512. ABSOLUTE INTENSITIES OF L X-RAYS AND GAMMA RAY IN RaD DECAY. R.W.Fink.
Phys. Rev., Vol. 106, No. 2, 266-71 (April 15, 1957).

The absolute intensity of L X-rays/RaD disintegration (F) has been measured to be $0.23_8 \pm 0.02$ by argon-filled proportional counti spectrometry on carrier-free RaDEF equilibrium sources, and the relative intensities were found to be $L_\alpha : L_\beta : L_\gamma :: 1.0 : 1.1 : 0.19$. The intensity of L X-rays relative to that (R) of the single, 46.5 keV pure M1 gamma-ray is $F/R = 5.1 \pm 0.7$. Care was taken to avoid error due to wall-effects and the counting techniques were varied a cross-checked so as to eliminate possible systematic errors. The absolute intensity of the gamma ray is $R = 0.045 \pm 0.004$ from data taken on a 3 x 3 inch NaI(Tl) scintillation spectrometer. Assuming the number of L-shell ionizations/RaD disintegration (I) to be 0.62, the mean L-fluorescence yield (F/I) of bismuth is 0.38 ± 0.02, whic when combined with the ratio F/R, leads to an experimental value o the total L-shell conversion coefficient (I/R), which thus is 13.3 ± 2 the major error arising from the correction of R for the contributi due to Compton backscattering, which amounts to some 10 to 20% depending on exact conditions of geometry and collimation. The va of the L-conversion coefficient interpolated from Rose's tables is 17.85, based on a point-charge nucleus. Better agreement is obtain with a value of about 12.7 from theoretical calculations of Sliv and Listengarten, who included a correction for the finite size of the nucleus. A new summary of mean L-fluorescence yields from nuclear excitation is presented which shows that the mean yields depend strongly upon the relative number of vacancies in the respe ive L subshells. A

539.1

6513. ANGULAR DISTRIBUTION OF GAMMA RAYS FOLLOWIN COULOMB EXCITATION IN EVEN–EVEN NUCLEI.
F.K.McGowan and P.H.Stelson.
Phys. Rev., Vol. 106, No. 3, 522-9 (May 1, 1957).

The angular distributions of gamma radiation from Coulomb excitation with respect to the incident proton beam on thick targets have been measured in the even–even nuclei Ru^{104}, Pd^{108}, Pd^{110}, Cd^{110}, Cd^{112}, Cd^{114}, Cd^{116}, $Os^{190,192}$, and Pt^{194}. The particle paramet a_ν for a thick target deduced from the measurements on Ru^{104}, Pd^{1} Cd^{114}, and Pt^{194} agree to within the accuracy of the experiments (±2 to 5% for a_2) with the numerical results from the quantum-mechan treatment of the Coulomb excitation process.

539.166.0

6514. ARGONNE 7.7-METER BENT-CRYSTAL GAMMA-RAY SPECTROMETER. D.Rose, H.Ostrander and B.Hamermesh.
Rev. sci. Instrum., Vol. 28, No. 4, 233-44 (April, 1957).

A bent-crystal gamma-ray spectrometer of the transmission type having a focal length of 7.7 metres has been built for studying neutron capture radiation. The source is placed inside the reacto CP-5 in a horizontal straight-through hole. The instrument is designed to utilize a 30 cm x 30 cm quartz plate cut normal to the (310) planes. Undiffracted radiation is absorbed by a baffle consisting of 108 Pb plates each 40 x 11 x 0.040 inches mounted betwee tapered spacers so as to focus on the virtual image of the source. The detector is an array of 16 NaI(Tl) crystals comprising a volun $10\frac{1}{2} \times 10\frac{1}{2} \times 2$ in. The drive system rotates the crystal one second o arc in 20 seconds. The 2:1 motion required between the crystal a the detector is maintained by an optical lever system. The Bragg angle is measured with an interferometer. The instrument now operates with a 10 x 15 x 0.6 cm crystal.

539.166

6515. INVESTIGATION OF γ-RAYS FROM NEUTRON SOURCES Po–Li AND Po–Mg. Yu.A.Nemilov and A.N.Pisarevskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 139-40 (1957). In Russian.

Gamma-spectra from Po–Li and Po–Mg sources were studie using a scintillation spectrometer. The gamma-energies observe were: Po–Mg: 0.23; 0.8; 1.25; 1.85; 2.3; 4.2 MeV, and Po–Li: and 0.47 MeV. Z.Krasuc

539.16

6516. MEASUREMENT OF THE RELATIVE INTENSITIES OF [GAMMA]-LINES BY A TWO-METRE CRYSTAL DIFFRACTION γ-SPECTROMETER. O.I.Sumbaev.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 247-50 (1957). In Russian.

Results for a number of lines in the γ-spectra of Ir^{192}, Ta^{182} and Ta^{183} are presented. The data for the Ir^{192} spectrum obtained

by a crystal diffraction spectrometer agree satisfactorily with the results derived from photoelectron and recoil electron measurements. A.

539.166.1

6517. INVESTIGATION OF U^{235} FISSION γ-RAYS IN THE ENERGY REGION UP TO 250 keV.
V.V.Sklyarevskiĭ, D.E.Fomenko and E.P.Stepanov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 256-62 (1957). In Russian.

A scintillation spectrometer using a NaI:Tl crystal or proportional counter connected in coincidence with a fission chamber were used to measure the U^{235} fission γ-ray spectrum in the energy range up to 250 keV. γ-ray lines of 30 ± 1.5 and 210 ± 10 keV energy were detected as well as a broad distribution in the 110 ± 15 keV region which apparently consists of several lines. It has been found that in the investigated energy region most of the fission γ-rays are emitted by fission fragments with lifetimes between 0.5×10^{-9} and 2.5×10^{-9} sec. Proportional counter measurements show that the 30 keV line is not monochromatic and corresponds to the K X-radiation of heavy fission fragments of various Z. A.

539.166.1

6518. SOFT 15-800 keV γ-RADIATION ACCOMPANYING U^{235} FISSION INDUCED BY THERMAL NEUTRONS.
V.K.Voĭtovetskiĭ, B.A.Levin and E.V.Marchenko.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 263-8 (1957). In Russian.

A number of lines have been detected in a scintillation spectrometer study of γ-rays correlated with fission fragments. It is shown that the 101, 119, 142, 207, 295, 360, 490 and 590 keV γ-quanta are due to γ-radiation accompanying fission. It is suggested that these γ-quanta are emitted by excited fragments after the ejection of neutrons. The intensive radiation possessing a peak at 27 keV is apparently due to K-lines from heavy fragments. A.

539.166.2 : 539.163.2

6519. GAMMA LINES FROM K^{43}. G.Bäckström and T.Lindqvist.
Ark. Fys., Vol. 11, Paper 40, 465-6 (1957).

Energy measurements by magnetic and scintillation spectrometer gave the results 373.7 ± 0.4 keV, 618.9 ± 0.6 keV and 1.02 ± 0.01 MeV. Coincidence scintillation spectrometer measurements indicated coincidence of the 374 keV line with 219 keV, 619 keV and 1.02 MeV lines. A revised decay scheme is presented. J.J.Wilkins

539.166.2

6520. THE γ-RAYS FROM THE 8.06 MeV LEVEL IN ^{14}N.
C.Broude, L.L.Green, J.J.Singh and J.C.Willmott.
Phil. Mag. (Eighth Ser.), Vol. 2, 499-504 (April, 1957).

The γ-rays emitted by the 8.06 MeV level in N^{14} have been examined using a scintillation spectrometer. The intensity of the isotopic spin forbidden transition to the 2.31 MeV state was measured and corresponds to a contamination of the 8.06 MeV T = 1 state with 8% of a T = 0 state. A possible reason for this high impurity is discussed. L.L.Green

539.166.2 : 539.152.1

6521. ANGULAR DISTRIBUTION OF GAMMA RAYS FROM COULOMB EXCITATION OF Pt AND W.
W.I.Goldburg and R.M.Williamson.
Phys. Rev., Vol. 106, No. 4, 782-4 (May 15, 1957).

Data on the unresolved 330 and 358 keV gamma-rays from thin natural platinum bombarded by 2 to 4 MeV protons show that the anisotropy of the angular distribution agrees closely with first-order Coulomb excitation theory. The thick-target anisotropy of the 114 keV gamma-rays from natural tungsten was found to be much more isotropic than the theory predicts. This result can be explained by assuming an extranuclear interaction between the excited tungsten nuclei and electric field gradients within the tungsten lattice. A.

539.166.74

6522. INCOHERENT SCATTERING OF GAMMA RAYS FROM THE BOUND ELECTRONS OF HEAVY ELEMENTS. J.Randles.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 337-47 (May, 1957).

In the experimental study of the coherent (elastic) scattering of gamma-rays of energy greater than 1 MeV from the electrons of heavy atoms, the energy resolution of the available detecting instruments makes it impossible to distinguish between photons scattered coherently and those scattered incoherently with an energy loss of up to about 10%. The experimental results therefore include an unknown amount of incoherent scattering, the contribution of which is calculated in this paper. The answer is stated as the ratio of incoherent to coherent cross-sections which is observed with a detector with the type of response to radiation assumed in the text, and the derivation is valid for large angles ($>\sim 60^0$) and the energies of interest ($\cong$ 1 MeV). Since the method of solution is much clearer in non-relativistic quantum mechanics, the necessary details were presented within this framework with an outline of procedure for the more exact relativistic theory. The ratio of the cross-sections for tin is given well by the non-relativistic approximation although the absolute cross-section is not. For heavier elements (e.g. mercury), only the relativistic theory is acceptable. A.

539.166.74

6523. THEORY OF MULTIPLE SCATTERING OF γ-RAYS.
V.S.Galishev, V.I.Ogievetskiĭ and A.N.Orlov.
Uspekhi fiz. Nauk, Vol. 61, No. 2, 161-216 (1957). In Russian.

A survey article covering such topics as: basic interaction processes of γ-rays with matter, radiation transfer equation, method of polynomial expansion and comparison of theoretical and experimental results, small-angle approximation, energy spectrum of γ-radiation at great depths of penetration, other methods of calculating multiple scattering. Useful list of over 70 classified references (one quarter Russian). C.R.S.Manders

539.166.75

6524. ABSORPTION OF γ-RAYS OF MEAN ENERGY 500 MeV IN LEAD, COPPER AND ALUMINIUM.
Yu.D.Bayukov, Yu.Ts.Oganesyan and A.A.Tyapkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 183 (1957). In Russian.

Results are in good agreement with the theory of Davies, Bethe and Maximon (Abstr. 5950/1954). G.E.Brown

539.166.83

6525. INTERNAL PAIR PRODUCTION IN THE ELECTRIC MONOPOLE $0^+ \rightarrow 0^+$ TRANSITION IN Zr^{90}.
T.Yuasa, J.Laberrigue-Frolow and L.Feuvrais.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2045-7 (Dec. 17, 1956). In French.

Positrons produced during a 1.74 MeV de-excitation in Zr^{90} were studied using a thick-lens magnetic spectrograph; the relative intensity $N_{e^+}/N_{\beta^-} = (5.4 \pm 0.8) \times 10^{-5}$. See also Abstr. 6133 (1956). A.O.Stanesby

539.166.83

6526. STUDY OF K-AUGER ELECTRONS AND OF CONVERSION ELECTRONS OF Co^{57}. J.B.Bellicard and A.Moussa.
J. Phys. Radium, Vol. 18, No. 2, 115-20 (Feb., 1957). In French.

An experiment using a double-focusing magnetic spectrometer is reported. Energies and relative intensities of K-Auger groups are tabulated. Measurements of K-conversion energies give the γ-ray energies $\gamma_1 = 121.94 \pm 0.03$ keV, $\gamma_2 = 136.31 \pm 0.03$ keV, $\gamma_3 = 14.37 \pm 0.01$ keV. The results of theoretical calculations of conversion coefficients and K/L ratios are tabulated, and comparisons with measured values are discussed in some detail. J.J.Wilkins

539.166.835

6527. ON THE ANNIHILATION DOPPLER EFFECT IN VARIOUS MATERIALS. G.Bäckström.
Ark. Fys., Vol. 11, Paper 26, 361-8 (1956).

Annihilation γ-ray lines from activated Cu, CuO and Cu—Al (mixture) sources have been studied with a double-focusing magnetic spectrometer. Cu and CuO give essentially identical line shapes (surprising since CuO lacks conduction electrons). The Al line is narrower, in agreement with existing data. For Cu, the expectation value $\bar{p} = 1.3$ (mc/137) is deduced for the momentum of annihilating positron—electron pairs, in agreement with results obtained by other methods, but at variance with a lower value, 0.52 (mc/137), deduced by Hedgran and Lind (Abstr. 5284/1952) from a similar investigation. J.J.Wilkins

539.166.835

6528. CROSS-SECTION FOR PHOTOPRODUCTION OF POSITRONIUM IN AN EXTERNAL FIELD INCLUDING RADIATIVE CORRECTIONS. A.I.Alekseev.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 909-10 (1956). In Russian.

Results are reported for the special case $Ze^2/\hbar c \ll v/c \ll 1$ and for high velocities. G.E.Brown

539.167.3

6529. NUCLEAR RECOIL USED TO PREPARE CARRIER-FREE RADIOACTIVE ISOTOPES. J.Pauly and P.Süe.
J. Phys. Radium, Vol. 18, No. 1, 22-6 (Jan., 1957). In French.

An extension of the technique previously described by Süe (Abstr. 1590/1956) for pile neutrons to the use of photons from the betatron and to deuterons from the cyclotron. By irradiation of a finely powdered target mixed with a solid or a liquid to act as a receiver of the recoil nuclei, carrier-free radioactive isotopes were extracted. The yields obtained for radioelements produced by (γ,n), (n,α) (n,p) and (d,p) reactions are about 20 to 30%. In addition by

measurement of the diameter of the target particles, it is possible to measure the range of the projected nuclei. This range increases with the recoil energy. T.A.Chalmers

NUCLEAR REACTIONS 539.17

539.172

6530. STRIPPING REACTION VIRTUAL LEVELS. O.Hittmair.
Acta phys. Austriaca, Vol. 10, No. 3, 255-60 (1956). In German.

The wave-mechanical formulation of the deuteron-stripping cross-section is developed for complex nuclei, applied to the virtual state of the captured neutron and compared with matrix theory. A.O.Stanesby

539.172 : 539.152.1

6531. REDUCED STRIPPING-WIDTHS AND THE SHELL MODEL. O.Hittmair.
Acta phys. Austriaca, Vol. 11, No. 1, 70-5 (1957). In German.

Summary of conclusions of shell-model theory on reduced widths in angular distribution, polarization and angular correlation for stripping reactions. A.O.Stanesby

539.172

6532. AN INVESTIGATION OF SPONTANEOUS NUCLEAR DISINTEGRATION BASED ON THE STATISTICAL MODEL. D.Kisdi.
Acta phys. Hungar., Vol. 6, No. 2, 251-9 (1956). In German.

The statistical model of the nucleus of Bohr and Wheeler is used to examine the stability of nuclei against spontaneous disintegration. Consideration of surface and kinetic energy and the adoption of a Yukawa force give values of Z = 107 and A = 266 as the critical nucleus. D.J.A.Prowse

539.172

6533. INVESTIGATION OF THE PRODUCTS OF NUCLEAR INTERACTIONS CAUSED BY THE NEUTRAL COMPONENT OF THE COSMIC RADIATION. A.V.Khrimyan.
Dokl. Akad. Nauk SSSR, Vol. 96, No. 6, 1155-8 (1954). In Russian.

The investigation has been carried out at 3250 m above the sea-level, with the help of a magnetic mass spectrometer, used in conjunction with a counter hodoscope and various layers of generators and absorbers. A conventional anticoincidence method has been used to trigger off the device and the ionizing prongs (with a momentum larger than 10^8 eV/c) produced in the interactions of the neutral component of the cosmic radiation have been recorded, and analysed by means of the range–momentum method. The spectra of the secondary particles, deduced under various operating conditions, have been classified according to the multiplicity of the stars and to the charge and mass of the prongs. G.Martelli

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172

6534. CATALYSIS OF NUCLEAR REACTIONS BETWEEN HYDROGEN ISOTOPES BY μ^- MESONS. J.D.Jackson.
Phys. Rev., Vol. 106, No. 2, 330-9 (April 15, 1957).

The mechanism by which negative μ-mesons catalyse nuclear reactions between hydrogen isotopes is studied in detail. The reaction rate for the process ($p + d + \mu^- \rightarrow He^3 + \mu^- + 5.5$ MeV), observed recently by Alvarez et al. (Abstr. 5651/1957), is calculated and found to be in accord with the available data. The μ^--meson binds two hydrogen nuclei together in the μ-mesonic analogue of the ordinary H_2^+ molecular ion. In their vibrational motion the nuclei have a finite, although small, probability of penetrating the Coulomb barrier to zero separation where they may undergo a nuclear reaction. The intrinsic reaction rates for other, more probable, reactions are also estimated. The results are $\sim 0.3 \times 10^6$ sec^{-1} for the observed p–d reaction, $\sim 0.7 \times 10^{11}$ sec^{-1} for the d–d reaction, and $\sim 0.4 \times 10^{13}$ sec^{-1} for the d–t reaction. For the reaction observed by Alvarez rough estimates are made of the partial widths for nonradiative and radiative decay of the excited He^3 nucleus. The ejection of the μ^--meson by "internal conversion" seems somewhat less likely. Speculations are made on the release of useful amounts of nuclear energy by these catalysed reactions. The governing factors are not the intrinsic reaction rate once the molecule is formed, but rather the time spent ($\sim 10^{-8}$ sec) by the μ^--meson between the breakup of one molecule and the formation of another and the loss of μ^--mesons in "dead-end" processes. These factors are such that practical power production is unlikely. In liquid deuterium, each μ^--meson will catalyse only ~ 10 reactions in its lifetime, while for the d–t proce it will induce ~ 100 disintegrations. A longer lived particle will not be able to catalyse appreciably more reactions. A.

539.172

6535. THE SCATTERING OF FAST CHARGED PARTICLES. II. ON THE SINGLE SCATTERING OF 9.8 MeV POSITRONS IN XENON.
K.R.Allen, E.A.Finlay, M.Lipsicas, D.Major and K.Phillips.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 355-60 (May, 1957).

For Pt I, see Abstr. 2929 (1956). The scattering of 9.8 MeV positrons in xenon in the angular interval 5-40° has been investigate using the cloud-chamber method. The results agree reasonably wel in this angular interval with the calculations of McKinley and Feshbach (Abstr. 1472/1949), in which Z is replaced by –Z. The ratio e^-/e^+ using the previous electron scattering results (Pt I), normalized to 9.8 MeV, also agrees well with McKinley and Feshbac in the 5-30° interval. A

539.172.

6536. INTERPRETATION ON NITROGEN- AND PROTON-INDUCED NUCLEAR REACTIONS.
R.Nakasima, Y.Tanaka and K.Kikuchi.
Progr. theor. Phys., Vol. 15, No. 6, 574-81 (June, 1956).

Excitation functions for α-, 2p- and 2α-emissions are calculate on the basis of the compound nucleus formalism for both of nitrogen-induced reactions on C^{12} and proton-induced reactions on Mg^{25}. The results are compared with the observed excitation curves in respec tive cases. A good agreement between the theoretical and the exper mental results in (p; 2p), (p; α) and (p; 2α) reactions indicates that the evaporation theory is valid for explaining the intermediate energ reactions even in those light nuclei. The overall behaviour of observed (N, α) and (N, 2p) excitation curves is in agreement with those obtained by the calculation and suggests that some sort of com pound nucleus is formed in the nitrogen-induced reaction. However the large magnitude of (N, 2α) cross-section cannot be explained by the successive emission of two alpha-particles, if the first alpha-particle emerges from the conglomorate nucleus proceeding toward the complete compound state. Hence the large (N, 2α) cross-sectio is regarded as due to direct processes such as alpha-capture or stripping. The occurrence of direct processes may explain a small discrepancy in the shape of (N, α) excitation curve at high incident energies. A

539.172.1

6537. INELASTIC SCATTERING OF 40.2 MeV ALPHA PARTICLES. G.Igo.
Phys. Rev., Vol. 106, No. 2, 256-60 (April 15, 1957).

The differential cross-section $d^2\sigma/dEd\Omega$ has been measured at 25, 45, 90, 135, and 150 degrees in the laboratory system for the inelastic scattering of 40.2 MeV alpha-particles from Al, V, Cu, Nb Ag, Ta, and Th. Spectra obtained at 135° and 150° have been analyse in terms of the statistical theory of nuclear reactions. The differential cross-section measured at smaller angles is incompatible with the statistical theory of nuclear reactions. A group of alpha-particles with energy well below the Coulomb barrier is observed i the spectra of Ta and Th at large angles. A

539.172.1

6538. ELASTIC SCATTERING OF ALPHA-PARTICLES BY HEAVY ELEMENTS. N.Oda and K.Harada.
Progr. theor. Phys., Vol. 15, No. 6, 545-60 (June, 1956).

The elastic scattering of 13-42 MeV alpha-particles by heavy elements has been analysed, using the boundary condition model of Feshbach and Weisskopf and the optical model with a complex poten tial of exponential shape in addition to the Coulomb potential. Resu for Ag and Au have been compared with experiments for the energy dependence of the elastic scattering and its angular distribution at 22 MeV. As for the energy dependence, the experimental data have been fitted fairly well with the results derived from both models, but for the angular distribution the agreement between experiments and theories is less satisfactory, especially for Ag data. The best fit procedure compels a considerably larger value to be assumed fo the radius of the alpha-particle than the usually accepted value, $R_\alpha \cong 1.2 \times 10^{-13}$ cm, using $R = r_0 A^{1/3}$ with $r_0 = 1.5 \times 10^{-13}$ cm for t nuclear radius. A

539.172.11 : 539.166.2 : 539.152.

6539. THE γ–γ ANGULAR CORRELATION IN THE REACTION $Be^9(\alpha,n\gamma\gamma)C^{12}$ AND THE SPIN OF THE SECOND EXCITED STATE OF C^{12}. K.G.Steffen and H.Neuert.
Z. Phys., Vol. 147, No. 2, 125-31 (1957). In German.

An anisotropy of about 100% was observed in this angular

correlation, after elimination of the effect of neutron—gamma coincidences. This indicates an assignment 0^+ for the 7.65 MeV state of C^{12}. J.W.G.Wignall

539.172.13 : 537.534.74

6540. TOTAL CROSS-SECTION FOR THE p—p INTERACTION IN THE ENERGY INTERVAL OF 410-660 MeV.
V.P.Dzhelepov, V.I.Moskalev and S.V.Medved'.
Dokl. Akad. Nauk SSSR, Vol. 104, No. 3, 380-3 (1955). In Russian.

The total cross-section increases monotonically from $(26.9 \pm 0.7) \times 10^{-27}$ cm^2 at 410 MeV to $(41.4 \pm 0.6) \times 10^{-27}$ cm^2 at 660 MeV. The cross-section for the reaction $p + p \rightarrow \pi^+ + p + n$ increases monotonically from $(2.6 \mp 2.0) \times 10^{-27}$ cm^2 at 460 MeV to $(11.9 \pm 2.3) \times 10^{-27}$ cm^2 at 660 MeV; the threshold energy for this reaction lies between 410 MeV and 460 MeV, which accounts for the large uncertainties in the lower-energy cross-sections. J.W.Gardner

539.172.13

6541. TOTAL CROSS-SECTIONS FOR 650 MeV PROTON REACTIONS WITH [CERTAIN] NUCLEI.
V.I.Moskalev and B.V.Gavrilovskii.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 6, 972-4 (1956). In Russian.

Protons from a 650 MeV proton synchrotron were allowed to interact with the following target materials: Be, C, Al, Cu, Sn, Pb and U. The method of measurement and the apparatus were those used in previously reported experiments on p—p and p—d interactions (see Abstr. 2330/1957 and preceding abstract). The results are presented as a tabulation of σ_{total}, σ_{abs}, σ_{scatt} and the ratio $\sigma_{abs}/\pi R^2$, with $R = 1.37 \times A^{1/3} \times 10^{-13}$ cm. Besides the elements listed above, a "calibration" measurement of σ_{total} for oxygen was included [obtained from $\sigma(O) = \sigma(H_2O) - 2\sigma(H)$]. The ratio $\sigma_{abs}/\pi R^2$ was found to increase monotonically with A, from 0.75 for Be to 0.98 for U. J.W.Gardner

539.172.13

6542. EMISSION OF α-PARTICLES OF LESS THAN 9 MeV IN DISINTEGRATIONS OF LIGHT AND HEAVY NUCLEI EXCITED BY PROTONS OF 1 GeV. G.Philbert.
J. Phys. Radium., Vol. 18, No. 1, 75-6 (Jan., 1957). In French.

The nuclei considered are those of C, N, O and Ag, Br in nuclear emulsions. A.O.Stanesby

539.172.13

6543. STUDY OF THE EXCITATION FUNCTIONS FOR THE REACTIONS $C^{12}(p,pn)C^{11}$, $Al^{27}(p,3pn)Na^{24}$ and $Al^{27}(p,3p3n)Na^{22}$ IN THE ENERGY INTERVAL 150-660 MeV.
Yu.D.Prokoshkin and A.A.Tyapkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 177-8 (1957). In Russian.

Protons of different energies are obtained by placing the targets at different distances from the centre of the accelerator. The radioactivity of the residual target was measured with a group of proportional counters. The extensive results here are compared with those of other authors. G.E.Brown

539.172.13

6544. COMPARISON OF THE REACTIONS $p + d \rightarrow H^3 + \pi^+$, $p + d \rightarrow He^3 + \pi^0$ AS A TEST OF CHARGE INDEPENDENCE.
K.C.Bandtel, W.J.Frank and B.J.Moyer.
Phys. Rev., Vol. 106, No. 4, 802-8 (May 15, 1957).

The pair of reactions $p + d \rightarrow H^3 + \pi^+$ and $p + d \rightarrow He^3 + \pi^0$ have been investigated experimentally to see if the predictions of the theory of charge independence are fulfilled. Because of the low cross-section (a few microbarns) and large background (heavy particles emitted at $\sim 10^0$ lab.) the results do not provide as critical a test as might be hoped. There is a 50% chance that the ratio of the reaction cross-sections $(p + d \rightarrow \pi^+ + H^3)/(p + d \rightarrow \pi^0 + He^3)$ is between 2.0 and 2.6. Charge independence predicts that the ratio should be exactly two. The experimental difficulties would be less at higher proton energies; this method would seem to provide a very stringent test of charge independence if the comparison could be made with sufficient accuracy. A.

539.172.13

6545. $C^{13}(p,p)C^{13}$: EXPERIMENT AND ANALYSIS.
D.Zipoy, G.Freier and K.Famularo.
Phys. Rev., Vol. 106, No. 1, 93-8 (April 1, 1957).

The differential cross-sections for the $C^{13}(p,p)C^{13}$ elastic-scattering interactions were measured over an energy range from 1.5 to 3.4 MeV (incident proton energy) at scattering angles of 45.0^0, 54.4^0, 74.1^0, 90.0^0, 106.4^0, 127.8^0, 148.9^0 in the centre-of-mass system. Methane gas, enriched to 72.5% in C^{13}, was used as a target material. The absolute differential cross-sections computed through this experiment were accurate to about 6% in the nonresonant energy regions. The measured nonresonant cross-sections at about 2 MeV were essentially equal to those for Coulomb scattering at $\theta = 45^0$ and increased to about seven times Coulomb cross-section at $\theta = 148.9^0$. There was also an increase in measured cross-section relative to the Rutherford cross-section at all scattering angles as the proton energy was increased. Maxima in the cross-sections were observed at incident proton energies of 2.00, 2.12, 2.33, 2.90, and 3.12 MeV. A phase-shift analysis of the resonances at 2.00, 2.12, and 2.33 MeV yielded assignments for J and π of 1^-, 3^-, and 1^+, respectively, and reduced widths relative to single-particle reduced widths of 0.10, 0.11, and 0.005, respectively. A.

539.172.13

6546. POLARIZATION OF HIGH-ENERGY NUCLEONS SCATTERED BY CARBON. K.Nishimura and M.Ruderman.
Phys. Rev., Vol. 106, No. 3, 558-60 (May 1, 1957).

Analyses of the polarization of elastically scattered 289 MeV protons from carbon show that it is difficult to understand the observed polarization even when a large variety of well shapes and parameters are introduced. The contribution from almost elastic scattering by C^{12} (excitation of the 4.3 MeV level) is calculated on the assumption that a low-lying energy level which is strongly excited can be considered a collective excitation. Then in the Born approximation the polarization is exactly the same as for elastic scattering, but more precise calculations show important differences. Separation of the elastic and inelastic polarization contributions with partial cross-sections inferred from electron scattering and 96 MeV nucleon scattering is in qualitative agreement with observation. A.

539.172.13

6547. POLARIZATION OF FAST PROTONS SCATTERED BY NUCLEI WITH INCLUSION OF THE ELECTROMAGNETIC SPIN-ORBIT COUPLING. T.Eriksson.
Nuclear Physics, Vol. 2, No. 1, 91-7 (Sept., 1956).

Calculations have been made on the polarization of protons scattered by carbon, aluminium and iron at 130 MeV, with special attention to the spin—orbit coupling caused by the electromagnetic interaction between the nucleus and the incident nucleon. The calculations show that the effect of this interaction is noticeable for small scattering angles up to around 10^0 at this energy. The effect should be more pronounced in the case of neutron scattering. A.

539.172.13

6548. POLARIZATION OF GeV PROTONS SCATTERED BY COMPLEX NUCLEI. G.E.Brown.
Proc. Phys. Soc. A, Vol. 50, Pt 5, 361-8 (May, 1957).

Polarization in the elastic scattering of GeV protons by carbon is calculated, assuming a model in which the nucleus is replaced by a complex spin-dependent phenomenological potential $V(r) = V_1(r) + \sigma.LV_2(r)$. Results are compared with Birmingham experiments. In order to set the parameters of V_1, a new derivation, valid for high energies, of the relationship between the phenomenological potential and the nucleon—nucleon scattering amplitudes is given. The results of the comparison with experiment are: (i) V_2 is mainly real, (ii) the same V_2 as was used at 300 MeV can explain experiment at 1 GeV. A.

539.172.13

6549. THE ELASTIC SCATTERING OF PROTONS BY FLUORINE.
G.Dearnaley.
Phil. Mag., Vol. 45, 1213-16 (Nov., 1954).

This was observed at four angles, with bombarding energies of 0.5 to 2.1 MeV. Anomalies were observed corresponding to the resonances in $F^{19} + p$ at 669, 831, 874, 935, 1355, 1381, 1431, 1690, 1940, and 2030 keV. The assignments of the various levels are discussed.

539.172.13

6550. THE ELASTIC AND INELASTIC SCATTERING OF PROTONS BY Mg.
G.W.Greenlees, B.C.Haywood, L.G.Kuo and M.Petravić.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 331-6 (May, 1957).

Absolute differential cross-sections are given for the elastic scattering by Mg of protons of energies 9.55 MeV, 9.13 MeV, 8.83 MeV, 8.62 MeV and 7.86 MeV, for an angular range of 25^0-165^0 (centre-of-mass coordinates). The angular distributions show characteristic maxima and minima due to nuclear interference with Coulomb scattering. Absolute differential cross-sections for the inelastic scattering of protons at these five energies from the 1.37 MeV level of Mg^{24} are also given. A marked variation of the angular distribution with energy has been noted. A.

539.172.13 : 539.172.4

6551. INELASTIC HIGH ENERGY NUCLEON SCATTERING ON LIGHT NUCLEI. T.A.J.Maris and H.Tyrén.
Nuclear Physics, Vol. 3, No. 1, 35-51 (March, 1957).

The excitation of a nucleus bombarded by nucleons of a few hundreds of MeV is considered as the result of individual interactions of the incoming nucleon with the nucleons of the nucleus. A simple two-particle model, in which a bombarding particle excites a particle moving in a potential well, has been calculated in the first Born approximation. It is shown that the resulting angular distributions have a strong forward dip and vanish at large angles. To a certain extent this result still holds for the case of a nucleus consisting of Fermi-particles with common and isobaric spins. In first order only those states can be excited whose wave-functions have, in the sense of the independent particle model, a component differing only in the state of one particle from the ground state wave-function. In the case of neutron scattering the cross-section has a forward dip if the space part of the wave-function of the excited particle is orthogonal to the space part of its ground state wave-function. If this is not so, for example if the excitation can occur by a pure spin exchange, there may be a forward maximum. In proton scattering the Coulomb interaction could result in a forward peaked angular distribution by dipole excitation as well as in the above mentioned case of a monopole transition. In higher approximation two or more particles in the nucleus can be simultaneously excited. The resulting cross-sections are expected to be smaller and more isotropic than in the case of a one-particle excitation. The angular distributions for two types of collective excitation have also been calculated, in the first Born approximation, namely for the lowest quadrupole surface vibration and for the dipole vibration of the nuclear charge. The qualitative features of the experimentally measured cross-sections of the scattering of 185 MeV protons on C^{12} are shown to be in agreement with the theoretical expectations. A.

539.172.13

6552. STUDIES OF INELASTIC SCATTERING OF 185 MeV PROTONS ON CARBON. H.Tyrén and T.A.J.Maris.
Nuclear Physics, Vol. 3, No. 1, 52-9 (March, 1957).

Studies were made using a magnetic analyser. Differential cross-sections of protons, exciting clearly resolved levels in C^{12}, are given. A.

539.172.13

6553. ELASTIC SCATTERING OF 32 MeV PROTONS FROM GOLD. S.N.Ghoshal and B.B.Baliga.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 324-30 (May, 1957).

The results of an experiment on the elastic scattering of 32 MeV protons from the Berkeley linear accelerator by gold, which had been performed several years ago, are reported. The photographic plates which had been employed for detection of the scattered protons have been recently scanned systematically. The differential scattering cross-section has been plotted as a function of the scattering angle. These include contributions of the inelastic scattering of protons from several low-lying levels in Au^{197}. To estimate this effect, the differential distribution of the ranges of the scattered protons in the photographic emulsion has been determined. From this range distribution curve the upper limit of the differential elastic scattering cross-section at various scattering angles has been estimated. The positions of the maxima and minima in the cross-section curve agree approximately with those given by the elementary theory of diffraction. The results have been compared with the theoretically calculated cross-sections obtained by employing Montroll–Greenberg (Abstr. 6350/1952) variational method using the optical type square well potential. A.

539.172.13

6554. INELASTIC SCATTERING OF NUCLEONS BY NUCLEI. R.Kajikawa, T.Sasakawa and W.Watari.
Progr. theor. Phys., Vol. 16, No. 2, 152-4 (Aug., 1956).

Calculation of the angular distribution in the reaction $Fe^{56}(p,p')Fe^{56*}$ (first excited state) for 17 MeV incident proton energy, taking account of the distortion of incident and outgoing waves in terms of an optical model potential and treating the interaction leading to excitation as a perturbation; the result is sensitive to the configuration assumed for the first excited state.

J.W.G.Wignall

539.172.13

6555. NEUTRON PRODUCTION FROM PROTON AND DEUTERON BOMBARDMENT OF NICKEL. K.W.Jones, T.H.Kruse, J.L.Weil, J.A.Baicker and L.J.Lidofsky.
Rev. sci. Instrum., Vol. 28, No. 1, 56-7 (Jan., 1957).

Laboratory cross-sections for the (d,n) and (p,n) reactions with Ni are given for bombardment of natural Ni foil by deuterons ($1.0 < E_d < 5.3$ MeV, 0.60 mg cm^{-2}) and protons ($2.4 < E_p < 6.0$ MeV, 2.33 mg cm^{-2}). [The legends of the two figures are transposed]. A.O.Stanesby

539.172.13

6556. MEASUREMENT OF THE $C^{12}(p,\gamma)$ AND $C^{12}(d,n)$ EFFECTIVE CROSS-SECTIONS FOR LOW-ENERGY BOMBARDING PARTICLES. A.S.Deĭneko, A.Ya.Taranov and A.K.Val'ter.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 251-5 (1957). In Russian.

A valve electrometer capable of measuring effective cross-sections down to $\sim 10^{-31}$ cm^2 was used. The instrument is weakly sensitive to the shape of the energy spectrum of the emitted particles. It yields directly the absolute values and permits one to determine the sign of the charge of the radioactive radiation. It can moreover be used to measure small as well as large radiation intensities without alteration of the geometry or change of the recording apparatus. The values of the yields for the reactions $C^{12}(p,\gamma)$ and $C^{12}(d,n)$ in thick targets in the energy range 300-400 keV agree satisfactorily with the shape of the analogous curves at energies above 400 keV found by other workers. The measured cross-section for the $C^{12}(p,\gamma)$ reaction in the 300 keV range is in good agreement with the value computed for this energy from the extrapolation formula. A.

539.172.13 : 539.152.1

6557. REACTION ENERGY OF $O^{18}(d,p)O^{19}$. K.Ahnlund.
Ark. Fys., Vol. 11, Paper 28, 379-81 (1956).

The Q-value for the ground state transition was found to be 1734 ± 5 keV. J.M.Cassels

539.172.13

6558. ANGULAR DISTRIBUTIONS OF PROTON GROUPS FROM THE REACTION $B^{10}(d,p)B^{11}$. B.Sjögren.
Ark. Fys., Vol. 11, Paper 29, 383-90 (1956).

The angular distribution for reactions leading to the 6.76, 6.81, and 7.30 MeV levels in B^{11} were measured. The incident deuteron energy was 800 keV, which complicates the application of stripping theory to the results. J.M.Cassels

539.172.13

6559. THE FORMATION OF He^5 BY THE DEUTERON BOMBARDMENT OF Li^7. A.C.Rivière.
Nuclear Physics, Vol. 2, No. 1, 81-90 (Sept., 1956).

The reaction $Li^7(d,\alpha)He^5(n)He^4$ has been studied at a deuteron energy of 900 keV by observing coincidences between alpha-particles concurrent with a measurement of their energies. The results are compared under certain assumptions and are consistent with the properties of He^5 as given by the scattering of neutrons in He^4. It is estimated that less than one tenth of the disintegrations observed are due to the alternative reactions $Li^7(d,n)Be^8(\alpha)He^4$ and $Li^7(d,n\alpha)He^4$. A.

539.172.13

6560. ENERGY LEVELS OF C^{11} AND ANGULAR DISTRIBUTIONS OF SOME NEUTRON GROUPS FROM THE $B^{10}(d,n)$ REACTION. M.Cerineo.
Nuclear Physics, Vol. 2, No. 2, 113-23 (Oct., 1956).

The energy spectrum and the angular distribution of separated neutron groups from the $B^{10}(d,n)$ reaction at 7.55 MeV deuteron mean energy have been determined. The resulting information on the excited states of C^{11} is presented. The angular distributions obtained are in agreement with the stripping theory. A.

539.172.13

6561. PROTON POLARIZATION IN (d,p) REACTIONS. J.Sawicki.
Phys. Rev., Vol. 106, No. 1, 172 (April 1, 1957).

Considers the proton spin–flip terms and gives a correction to one of the equations deduced by Cheston (Abstr. 2181/1955). J.M.Zarzycki

539.172.13

6562. POLARIZATION IN THE $H^2(d,p)H^3$ REACTION. R.E.Segel and S.S.Hanna.
Phys. Rev., Vol. 106, No. 3, 536-9 (May 1, 1957).

The polarization of the protons in this reaction has been measured at a deuteron energy of 0.64 MeV in the laboratory system, and a proton angle 45° in the centre-of-mass system. The deuterium gas target was approximately 70 keV thick. Scattering in helium gas was used to measure the polarization. Corrections for geometrical asymmetries were determined by comparing the scattering in helium with scattering in xenon gas. Measurements made at three different proton energies yield an average value of $-(17 \pm 7)\%$ for the polarization. The negative sign signifies a direction opposite the vector $[V_d \times V_p]$, where V_d and V_p are the deuteron and proton velocities, respectively. A.

539.172.13 : 539.185

6563. ANGULAR DISTRIBUTIONS OF THE $B^{11}(d,n)C^{12}$ GROUND-STATE NEUTRONS. O.Ames, G.E.Owen and C.D.Swartz.
Phys. Rev., Vol. 106, No. 4, 775-8 (May 15, 1957).

The angular distributions of the ground-state neutrons from the reaction $B^{11}(d,n)C^{12}$ have been measured in the deuteron energy range of 0.500 to 1.15 MeV. A single stilbene crystal counter was employed as a neutron detector. At a bombarding energy of 0.8 MeV the neutron angular distribution exhibits a strong forward component, while at 1.15 MeV the distribution is more isotropic. The data are consistent with an analysis based on nuclear stripping theory. A.

539.172.13

6564. THE STRIPPING THEORY OF DEUTERON REACTIONS AND THE INELASTIC SCATTERING OF DEUTERONS.
W.M.Fairbairn.
Proc. Roy. Soc. A, Vol. 239, 448-72 (Jan. 29, 1957).

The wave-functions for the deuteron stripping process are constructed in a concise form, using the approximations of Butler (1951). The resulting theoretical cross-section for (d, p) reactions is determined in terms of the nuclear constants, namely, the reduced widths and the logarithmic derivatives of the target nucleus. The interaction between the neutron and the proton after the stripping has taken place is introduced, and it is shown that the inelastic scattering of deuterons is then predicted. Using the zero-range approximation for the neutron–proton interaction the differential cross-section for (d, d') reactions is obtained. However, the formula is complicated and unsuitable for comparison with experimental results. An approximate expression is derived for the cross-section and comparison is made with the data available on the Mg^{24} (d, d') Mg^{24*} reaction, but it seems improbable that (d, d') reactions will prove to be useful for determining spins and parities of nuclear levels. A.

539.172.13

6565. GENERAL THEORY OF DEUTERON INDUCED REACTION. I. (d,p) AND (d,n) REACTIONS. H.Ui.
Progr. theor. Phys., Vol. 16, No. 4, 299-319 (Oct., 1956).

Taking into account the loosely bound nature of deuteron, the general theory of compound nucleus formation by deuterons is developed as a two-step process: first the neutron enters into the target nucleus to form a compound state and then the proton, combined with it, forms another compound state. Stripping process is obtained as a correction term of the compound nucleus process due to the interaction in the external proton channel. The indirect stripping process is also discussed. A.

539.172.13

6566. EFFECT OF THE FINITE MASS OF THE TARGET NUCLEUS ON THE ANGULAR DISTRIBUTION OF PRODUCTS OF (dp) AND (dn) REACTIONS. D.P.Grechukhin.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 895-7 (1956). In Russian.

Butler's stripping formula, which assumes the target mass to be infinite, is corrected for the finiteness of this mass. A calculation for $Be^9(d,p)Be^{10}$ with E_d = 3.6 MeV is carried out. G.E.Brown

539.172.13

6567. ABSOLUTE VALUES OF CROSS-SECTIONS OF STRIPPING AND OF DIFFRACTIVE DISSOCIATION OF THE DEUTERON. I.I.Ivanchik.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 164-5 (1957). In Russian.

Expressions are given for the stripping and the diffractive dissociation cross-sections of the deuteron on a black nucleus, which were derived taking into account the finite radius of neutron–proton forces in the deuteron. It is shown, that the cross-section of diffractive dissociation is insensitive to the choice of radius of the force, but that the stripping cross-section is dependent on that choice. Z.Krasucki

539.172.13

6568. ANGULAR DISTRIBUTION OF PRODUCTS OF THE REACTION $S^{32}(d,p)S^{33}$. I.B.Teplov, B.A.Yur'ev and T.N.Markelova.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 165-6 (1957). In Russian.

Angular distributions of protons, formed in the reaction $S^{32}(d,p)S^{33}$ with deuteron energies 1.8 and 3.8 MeV, were measured for two groups of protons, p_0 and p_1, corresponding to the formation of final nucleus in the ground and the first excited states. It is shown that theoretical curves describe well the position of the main maximum for the group p_1. In the angular distribution of the group p_0, the maximum is somewhat wider than follows from the theory and displaced to smaller angles. Relatively large secondary maxima were found at about 115° for the p_0 group and at about 60° for the p_1 group. The maxima increase with increasing energy of incident deuterons. The angular distribution of p_1 group shows a considerable increase in the region near to 180°. Z.Krasucki

539.172.13

6569. DIFFERENTIAL CROSS SECTION FOR THE $C^{13}(He^3,\alpha)C^{12}$ REACTION AT 2.00 MeV. H.D.Holmgren.
Phys. Rev., Vol. 106, No. 1, 100-1 (April 1, 1957).

The differential cross-sections for the $C^{13}(He^3,\alpha)C^{12}$ reaction have been measured for ground state and first excited state α-particle groups at a bombarding energy of 2.00 MeV for sixteen centre-of-mass angles extending from 5° to 152°. These data have been fitted with Legendre polynomial expansions including polynomials up to the sixth degree by the method of least-squares. The coefficients in these expansions and the total cross-sections are tabulated. A.

539.172.3

6570. CONTRIBUTION OF THE ELECTRIC FIELD OF NUCLEI TO THE ELASTIC SCATTERING OF γ-RAYS OF Co^{60}.
L.Goldzahl and P.Eberhard.
J. Phys. Radium, Vol. 18, No. 1, 33-43 (Jan., 1957). In French.

The elastic scattering cross-section has been measured at angles between 35° and 135° for lead, uranium and tin, using a scintillation γ-spectrometer. The results are compared with theoretical estimates of Rayleigh and Thompson scattering, and indicate a new scattering component in destructive interference with the Rayleigh and Thompson scatterings. Accurate calculation of the Rayleigh scattering will permit determination of the amplitude of the new process, which is attributed to vacuum polarization by the electric field of the nucleus. J.J.Wilkins

539.172.3

6571. CROSS SECTION OF THE $I^{127}(\gamma,n)I^{126}$ REACTION.
J.Erö and L.Keszthelyi.
Nuclear Physics, Vol. 2; No. 4, 371-81 (Dec., 1956).

A NaI(Tl) scintillation crystal was irradiated with the gamma radiation of the Li(p,γ) reaction. From the number of scintillations during the irradiation, and from the activity of the I^{126} isotope after the irradiation the cross-section of the $I^{127}(\gamma,n)I^{126}$ reaction was determined. The measurements give $\sigma(\gamma,n) = 125 \pm 6$ mb. Combining this with the results of other measurements in which neutrons were counted, gave the value $\sigma(\gamma,2n) = 30 \pm 20$ mb for the $I^{127}(\gamma,2n)I^{125}$ reaction. The ratio of the K-capture of the I^{126} isotope to the total number of disintegrations has also been determined. It was found to be 0.51 ± 0.03. A.

539.172.3

6572. PHOTODISINTEGRATION OF C^{13}. B.C.Cook.
Phys. Rev., Vol. 106, No. 2, 300-14 (April 15, 1957).

The neutron yield functions of C^{12} and C^{13} from bremsstrahlung up to 41 MeV have been measured by using direct neutron detection. The photoproton yield function for C^{13} has also been measured by detecting the B^{12} activity. These yield functions were converted into cross-sections (σ) by a slightly modified standard method. σ for $C^{13}(\gamma,xn)$ exhibits a peak of ~ 3.7 mb at ~ 13.5 MeV and the "giant resonance" peak of ~ 10 mb at ~ 24 MeV. This latter peak is broad [$\Gamma_{1/2} \cong 10$ MeV] in contrast to C^{12} with $\Gamma_{1/2} \cong 3$ MeV. σ for $C^{13}(\gamma,p)B^{12}$ exhibits a broad ($\Gamma_{1/2} \cong 6$ MeV) giant resonance peak of 8.8 mb at 25.5 MeV. This large p/n emission ratio cannot be accounted for by statistical considerations. After a reasonable allowance is made for multiple processes, these two measurements are combined to give the total γ-absorption cross-section, σ_{abs}. σ_{abs} of C^{12} is also discussed. Both show a giant resonance peak but $\Gamma_{1/2}(C^{13}) \gg \Gamma_{1/2}(C^{12})$ whereas the integrals of σ_{abs} over the resonance are approximately equal. The idea that core excitation is responsible for the giant resonance is supported by the approximate equality of the resonance energies of C^{12} and C^{13}, but the remarkable difference in the width of these resonance peaks suggests a strong dependence of the absorption process on the ground-state configurations. The peak at 13.5 MeV found in $C^{13}(\gamma,n)$ is still present in σ_{abs} and hence is not due to competition, but represents a "pygmy resonance". During this work a new half-life for B^{12} was obtained: $(18_{-1.3}^{+1.5})$ msec. A.

539.172.3

6573. PHOTODISINTEGRATION OF HELIUM.
M.L.Rustgi and J.S.Levinger.
Phys. Rev., Vol. 106, No. 3, 530-5 (May 1, 1957).

The sum-rule calculations of Levinger and Bethe are extended to include two-body Heisenberg and tensor forces. These sum rules are applied to calculate for the alpha-particle the bremsstrahlung-weighted cross-section (σ_b) and the integrated cross-section (σ_{int})

using Irving's wave-function for tensor force. The results are compared with values found from experiments integrated to 150 MeV. The experimental values are σ_D = 2.7 mb and σ_{int} = 124 MeV-mb, while the theoretical values are found to be σ_D = 1.23 mb and $\sigma_{int} = 60[1 + 0.70(x + \frac{1}{2}y) + 0.18(x' + \frac{1}{2}y')]$ MeV-mb. Here x and x' are the fractions of central and tensor potentials, respectively, that have Majorana exchange character; y and y' represent fractions of the central and tensor potentials that have Heizenberg exchange character. The low theoretical values for σ_D may be related to the small root-mean-square radius of the alpha-particle given by Irving's wave-function. The photodisintegration experiments seem to support Hofstadter's value for the size of the alpha-particle, when one takes account of the proton size in his electron-scattering experiments. A.

539.172.3

6574. FINAL-STATE INTERACTIONS IN THE TOTAL CROSS SECTION FOR DEUTERON PHOTODISINTEGRATION. J.Bernstein.
Phys. Rev., Vol. 106, No. 4, 791-2 (May 15, 1957).

Estimates the role of final-state interactions in the theory of the total cross-section for photodisintegration of the deuteron at high energies. The Feshbach–Lomon model of nucleon–nucleon scattering was employed. Within the context of this model, final-state effects were found to enhance the total cross-section by about 15 to 20% over the usual electric dipole calculation for photon energies around 60 MeV. A.

539.172.3

6575. DEUTERON PHOTODISINTEGRATION AT HIGH ENERGIES. R.Suzuki.
Progr. theor. Phys., Vol. 15, No. 6, 536-44 (June, 1956).

The problem of deuteron photodisintegration at high energies relates to meson scattering in the intermediate states. This process is investigated by making use of the Tamm–Dancoff method which involves the p-wave interaction of virtual mesons. A.

539.172.3

6576 PHOTOFISSION CROSS SECTIONS OF U^{235}, U^{238}, Th^{232}, Bi^{209}, AND Au^{197} AT ENERGIES OF 150 TO 500 MeV.
J.A.Jungerman and H.M.Steiner.
Phys. Rev., Vol. 106, No. 3, 585-90 (May 1, 1957).

Cross-sections have been measured by use of bremsstrahlung spectra whose maximum energies ranged from 150 to 500 MeV. The fissions were detected in 2π geometry with a double ionization chamber. A suggested correlation of the resulting cross-sections with those for proton fission and for photomeson production is made. A.

539.172.3

6577. FISSION OF U, Th, Bi AND Tl INDUCED BY HIGH-ENERGY γ-QUANTA. E.V.Minarik and V.A.Novikov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 241-6 (1957). In Russian.

The photofission yields of U^{238}, Th^{232}, Bi^{209} and $Tl^{204,206}$ have been measured with an ionization chamber at bremsstrahlung peak energies from 80 to 250 MeV. The photofission effective cross-sections computed by the total spectrum method rapidly increase from ~ 80 MeV and at 250 MeV reach a value of (220 ± 80) millibarns for U, (80 ± 30) millibarns for Th, (4.7 ± 0.6) millibarns for Bi and (1.6 ± 0.2) millibarns for Ti. The energy dependence of the cross-sections is the same for all four elements and, above 150 MeV, is similar to the energy dependence of the total cross-section for photoproduction of neutral and charged mesons. A.

539.172.3 : 539.18

PHOTOPRODUCTION OF π^0 MESONS IN HYDROGEN. See Abstr. 5656

539.172.3 : 539.18

ON THE ROLE OF COMPOUND STATES IN PHOTOPRODUCTION PROCESSES. See Abstr. 5655

539.172.4

6578. GROUND-STATE TRANSITIONS IN THE REACTION $^{10}B(n,t)^{8}Be$. E.W.Titterton and T.A.Brinkley.
Nature (London), Vol. 179, 368-9 (Feb. 6, 1957).

The $B^{10}(nt2\alpha)$ reaction has been investigated using neutron beams of 14.1 MeV energy falling on 200 μ thick boric-acid-loaded plates. Of 360 three-particle stars due to the above reaction nine are deduced to involve the formation of Be^8 nucleus in its ground state, the Be^8 subsequently splitting into two α-particles. The cross-section for the $B^{10}(n,t)Be^8$ reaction, leaving the Be^8 in its ground state, is therefore about 3% of the total $B^{10}(nt2\alpha)$ cross-section. D.R.Chick

539.172.4

6579. DIFFERENTIAL ELASTIC SCATTERING OF 14 MeV NEUTRONS IN LEAD, MERCURY AND ZINC. H.Nauta.
Nuclear Physics, Vol. 2, No. 2, 124-31 (Oct., 1956).

The differential cross-sections have been measured in a ring geometry using a biased detector with a spherical liquid scintillator. The measurements were taken over the angular range between 15° and 125°. The results are in qualitative agreement with theoretical predictions. A.

539.172.4 : 539.152.1

6580. $F^{19}(n,d)O^{18}$ REACTIONS AND ENERGY LEVELS OF O^{18}. F.L.Ribe.
Phys. Rev., Vol. 106, No. 4, 767-71 (May 15, 1957).

The differential cross-sections for the reactions $F^{19}(n,d)O^{18}$ leading to the ground- and first-excited states of O^{18} have been measured. Higher excited states were also observed but with insufficient accuracy for measurement of the corresponding cross-sections. Comparison with results of pickup theory indicates a proton s-wave transition to the ground state of O^{18} and a probable d-wave transition of approximately equal reduced width to the first excited state. The estimated ratio of the two reduced widths is in agreement with recent theoretical results. A.

539.172.4

6581. ROTATIONAL EXCITATION WITH NEUTRON INELASTIC SCATTERING. M.Yasuno.
Progr. theor. Phys., Vol. 15, No. 6, 586-8 (June, 1956).

Inelastic neutron scattering cross-sections are calculated using the collective model to describe the compound nucleus and target nucleus. Strong-coupling approximation is used and the excitation function calculated according to the compound nucleus theory of Teichman and Wigner (Abstr. 7537/1952). The theoretical results are compared with experimental results for the inelastic scattering of neutrons by Pb^{206}. L.L.Green

539.172.4

6582. ELASTIC SCATTERING OF NEUTRONS BY HEAVY NUCLEI THROUGH SMALL ANGLES.
V.S.Barashenkov, I.P.Stakhanov and Yu.A.Aleksandrov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 154-6 (1957). In Russian.

The most favourable situation to observe the polarization scattering of neutrons, that is, the interaction between the induced electric dipole of the neutron and a Coulomb field, is calculated. Comparison with experiment indicates that the effect is generally very small. W.O.Lock

539.172.4

6583. ANGULAR DISTRIBUTION OF FRAGMENTS IN THE FISSION OF URANIUM^{238} BY NEUTRONS OF VARIOUS ENERGIES.
A.A.Varfolomeev, A.S.Romantseva and V.M.Kutukova.
Dokl. Akad. Nauk SSSR, Vol. 105, No. 4, 693-5 (1955). In Russian.
English Translation in: Atomic Energy Res. Establ. (Harwell) Transl. No. 707 (1956).

Groups of Ilford D1 photographic plates saturated with a 5% aqueous natural uranyl acetate solution were bombarded with neutrons of energies 4, 12, 14, and 17 MeV. The angular distribution of fission fragments was measured in 15° intervals. Histograms show that the anisotropy in the distribution increases up to 12 MeV but remains approximately constant for bombarding energies of 12, 14, and 17 MeV. R.D.Smith

539.172.

6584. FISSION MODES OF $_{94}Pu^{242}$.
A.B.Smith, P.R.Fields and A.M.Friedman.
Phys. Rev., Vol. 106, No. 4, 779-81 (May 15, 1957).

The neutron-induced fission of Pu^{241} ($Pu^{241} + n_{th} = Pu^{242*}$) and the spontaneous fission of Pu^{242} were studied by using a back-to-back ionization chamber. The two processes were found to be asymmetric and essentially identical. The most probable values of the mass ratio and total fragment kinetic energy were measured to be 1.38 and 174 MeV, respectively. The experimental results are compared with those from other fission processes and with existing theory. A.

539.172.

6585. EFFICIENCY OF CONTROL RODS AS A FUNCTION OF THEIR POSITION IN A CYLINDRICAL PILE IN THE ONE GROUP PICTURE. F.T.Adler.
Atomic Energy of Canada Rep. 253, 39 pp. (Feb. 12, 1947).

The effectiveness of a single eccentric control rod or poison channel in a reactor is calculated as a function of its position using the one-group method. The effect of the rod is separated into an

effect due to neutron leakage out of the system and that due to neutron leakage into the rod, and calculated as a function of radius. By considering the interference effects between rods the results are extended to the case of a ring of control rods. R.D.Smith

539.172.4

6586. DETERMINATION OF THE CRITICAL VOLUME OF A SPHERICAL REACTOR. G.Bouquet, F.Ceschino, M.Feix, R.Loutfoullah, P.Nicourd and A.Sestier.
C.R. Acad. Sci. (Paris), Vol. 244, No. 2, 165-8 (Jan. 7, 1957). In French.

Theoretical. Describes a method for finding the critical conditions of a spherical reactor with reflector: the system is divided into concentric shells and the criticality is obtained from the matrix of the resulting linear equations. It is shown by means of an example that the results converge rapidly as the number of shells is increased. J.W.G.Wignall

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

6587. NOTE ON THE NUMBER OF DIFFERENT TYPES OF K-MESONS. I.Pomeranchuk.
Nuclear Physics, Vol. 2, No. 3, 281-2 (Nov., 1956).

The probability of 2π and 3π decay of the two K-mesons formed in certain proton reactions is shown to depend on whether one or two different types of K-mesons exist. E.J.Burge

539.18

6588. COMPOUND MODEL FOR HEAVY PARTICLES. R.W.King and D.C.Peaslee.
Phys. Rev., Vol. 106, No. 2, 360-3 (April 15, 1957).

A static model is considered in which all heavy particles are compounded out of two basic units, taken here to be the Λ and nucleon N (and/or the cascade particle Ξ). The model suggests the existence of some unstable particle states accessible to experiment: the ρ meson, a boson with I = 0; the Λ^{**}, a highly excited I = 0 state of the Λ; the Z hyperon unstable against rapid decay by $Z \rightarrow K + N$. Without artificial assumption the model directly indicates that in the present strangeness classification no metastable V-particles exist beyond those already known. The model is compatible with and somewhat favours the assumption of a high degree of symmetry between N and Ξ. Its general tenor is thus to emphasize the charge displacement $a = q - I_z$ as a physically significant parameter rather than the strangeness S. An unavoidable implication of the model is that all heavy particles have comparable interaction strengths, apparent exceptions being possible over limited energy ranges. The model provides a vehicle for study of the parity doublet scheme, which introduces greater complication in return for an added flexibility at present unnecessary in the model. A.

539.18

6589. ON THE QUANTITIES WITH ANOMALOUS PARITY AND POSSIBLE EXPLANATION OF PARITY DEGENERACY OF THE K-MESONS. I.M.Gel'fand and M.L.Tsetlin.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1107-9 (1956). In Russian.

In recent months evidence has accumulated, in the form of decay particle distributions, for the degeneracy of mass, excitation function and parity of the various K-mesons. The possibility of an interference effect between parity doublets, and its influence on the decay distributions, are critically examined in the present paper. J.W.Gardner

539.18

6590. PHYSICAL MODEL OF THE HYPERON. G.d'Erdi.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 152-4 (1957). In Russian.

The hypothesis that hyperons are bound states of nucleons and $\bar{K}$-mesons is reviewed in the light of the latest information. It is shown how the observed particles can be predicted, and how by considering the behaviour of the K-nucleon interaction under charge conjugation the nonappearance of other particles is explained. W.O.Lock

539.18

6591. ON UNSTABLE CHARGED PARTICLES HEAVIER THAN PROTONS. A.I.Alikhanyan, M.I.Daĭon, N.V.Shostakovich, V.G.Kirillov-Ugryumov and B.N.Deryagin.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 3, 361-4 (1954). In Russian.

Six such particles are considered. They were recorded at 3250 m using a magnetic spectrometer in conjunction with a rectangular Wilson chamber (60 x 28 x 18 cm). In each case an incident particle T^+ emits near the end of its path a secondary particle. The following schemes are proposed: $T^+ \rightarrow n^0 + \pi^+(\mu^+) + Q$. These appear to be consistent with the evidence but it has not been possible to distinguish between them. From the disintegration schemes, if the secondary particle is a π-meson then Q = 66 MeV and $m_T = 2246\ m_e$. If it is a μ-meson then Q = 58 MeV and $m_T = 2160\ m_e$. Direct measurement yielded $2000\ m_e < m_T < 2600\ m_e$. S.Chomet

539.18

6592. FURTHER EVIDENCE FOR THE β-DECAY OF K-MESONS. C.Dahanayake, P.E.Francois, Y.Fujimoto, P.Iredale, C.J.Waddington and M.Yasin.
Phil. Mag., Vol. 45, 1219-21 (Nov., 1954).

An event similar to that of Abstr. 11445 (1954) is described, in which the secondary electron has an energy of only 50 MeV.

539.18

6593. THEORY OF μ-MESON DECAY WITH THE HYPOTHESIS OF NONCONSERVATION OF PARITY. C.Bouchiat and L.Michel.
Phys. Rev., Vol. 106, No. 1, 170-2 (April 1, 1957).

A degree ζ ($-1 < \zeta < 1$) of μ-meson polarization is introduced and the electron spectrum calculated as a function of the angle between the electron momentum and the muon polarization vector. This involves parameters for which different ranges are obtained according to whether the muon decays with emission of two like neutrinos or with emission of one neutrino and one antineutrino. In the β-decay Hamiltonian there are five constants for even and five for odd coupling. Non-conservation of parity can be introduced by using one new constant relating the odd and even coupling constants. In the case of zero mass neutrinos this constant, ξ, can be interpreted as the degree of circular neutrino polarization. The limiting case $|\xi| = 1$ has been considered by Salam and by Lee and Yang. In this case $\zeta = \pm \xi$, the sign depending on whether an antineutrino or a neutrino is emitted in the $\pi-\mu$ decay. The electron angular distribution is given by $1 - S\zeta \cos\theta$. The asymmetry $S\zeta$ depends on ζ. Moreover the range of possible values for the asymmetry depends on the neutrino species emitted. It is not stated whether this allows experimental discrimination between neutrino and neutrino antineutrino emission. H.Motz

539.18

6494. CHARGE ASYMMETRIES IN THE DECAY OF LONG-LIVED NEUTRAL K MESONS. H.W.Wyld, Jr. and S.B.Treiman.
Phys. Rev., Vol. 106, No. 1, 169 (April 1, 1957).

If these are discovered, it is shown that either there are two different types of K-mesons or time reversal invariance does not hold. If there are time variations in the asymmetry the first possibility holds. See also Abstr. 742 (1957). E.J.Burge

539.18 : 530.145

6595. K^0 DECAY MODES AND THE QUESTION OF TIME REVERSAL OF WEAK INTERACTIONS. R.Gatto.
Phys. Rev., Vol. 106, No. 1, 168 (April 1, 1957).

Examines the consequences of invariance under time reversal by considering the equivalent conservation of L(= CP) [Luders–Pauli theorem]. In particular the long-lived component of the K^0 mixture must never decay into two pions and the branching ratio for decay into $e^-\pi^+\nu$ and $e^+\pi^-\nu$ must be unity. K.H.Barker

539.18

6596. FERMI DECAY OF HIGHER SPIN PARTICLES. R.E.Behrends and C.Fronsdal.
Phys. Rev., Vol. 106, No. 2, 345-53 (April 15, 1957).

The explicit form for the spin projection operators introduced by Fronsdal is calculated for arbitrary spin and applied to first order processes involving four fermions. The matrix element for the most general nonderivative interaction is found for the special case in which two of the particles have spin $\frac{1}{2}$. The method of relating matrix elements written in different orders is extended to this case. The theory is applied to the decay of the μ meson, extending the work of Caianiello. It is found that the experimental decay spectrum can be equally well fitted by an assignment of spin $\frac{1}{2}$ or $\frac{3}{2}$. The method is then applied to the Fermi decay of hyperons. Lifetimes are calculated for decays in which the initial particle has a spin of $\frac{1}{2}$ or $\frac{3}{2}$, and the final particles all have spin $\frac{1}{2}$. All the lifetimes are less than 2 orders of magnitude longer than the corresponding observed lifetimes for the normal mode of decay. The hypothesis of a universal Fermi interaction is extended to include fermions of arbitrary spin. Under this hypothesis, the experimental muon spectrum is most closely reproduced with spin $\frac{3}{2}$. The results also indicate that the muon has the same particle–antiparticle character as an electron of the same charge. A.

539.18

6597. PARITY DOUBLETS AND HYPERFRAGMENT BINDING. L.M.Brown.
Phys. Rev., Vol. 106, No. 2, 354-7 (April 15, 1957).

The Thomas variation-iteration method is applied to a model of a hypernucleus in which the binding arises from a potential which mixes orbital states of opposite parity, a situation which may prevail if the Λ^0 has the parity doublet structure suggested by Lee and Yang (Abstr. 3997/1956). The P-state part of the ground state increases with the mass of the hyperfragment and may have a probability as large as 20% for mass number 8, with correspondingly large effect upon the decay rate of the fragment and upon the ratio of mesonic to nonmesonic decay. A.

539.18

6598. μ-MESON DECAY AND THE TWO-COMPONENT NEUTRINO. M.H.Friedman.
Phys Rev., Vol. 106, No. 2, 387 (April 15, 1957)

Remarks that the experimental values of the Michel parameter (ρ) and the back–front (B/F) ratio for decay electrons between 0 and 10 MeV seem inconsistent with predictions of the two-component theory assuming the decay process: $\mu \rightarrow e + \nu + \bar{\nu}$. It is suggested that in addition there may be a decay into $e + 2\nu$ (or $2\bar{\nu}$) which will enable a fit to be made by suitable choice of coupling constants. The assymetry parameter (α) and B/F are tabulated for several values of ρ and the coupling constants. K.H.Barker

539.18

6599. K-MESON DECAYS THROUGH A FERMI INTERACTION. J.C.Polkinghorne, D.L.Pursey and H.A.Santa Maria.
Proc. Phys. Soc. A, Vol. 70, Pt 5, 321-3 (May, 1957).

The decay of K-mesons by means of a weak Fermi interaction is investigated. For the decay of the θ^+ into π^+ and π^0 only $\Delta I = 3/2$ contributes. It is shown that if the only hyperon taking part is Λ then the interaction must be S-A-P for pure $\Delta I = 3/2$. The case in which other hyperons participate is considered. For a Σ-nucleon interaction it is necessary to have S-A-P for pure $\Delta I = 5/2$. Some other less specific results are also obtained. A.

539.18

6600. THE DECAY INTERACTION OF $K_{\mu 3}$ AND K_{e3} AND FERMI INTERACTION.
S.Furuichi, T.Kodama, Y.Sugahara, M.Yonezawa and A.Wakasa.
Progr. theor. Phys., Vol. 16, No. 1, 64-6 (July, 1956).

The energy spectra of the secondary muon or electron from K-meson decays are calculated assuming weak Fermi interaction. J.W.Sturgess

539.18

6601. PROBLEM OF K^0-DECAYS. I.Yu.Kobzarev.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 180-1 (1957). In Russian.

A possible experiment for establishing parity in K-meson decay by observing their lifetimes is described. G.E.Brown

539.18

6602. τ-MESON DECAY. I.N.Mikhaĭlov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 284-8 (1957). In Russian.

The energy spectrum of π-mesons created in τ-meson disintegrations has been computed on the assumption that the τ-meson isotopic spin is equal to unity. A.

539.18

6603. MEAN LIFE OF K^--MESONS AND THEIR CROSS SECTION IN HYDROGEN. B.Cork, G.R.Lambertson, O.Piccioni and W.Wenzel.
Phys. Rev., Vol. 106, No. 1, 167-8 (April 1, 1957).

In the negative external beam from the Bevatron K^- mesons were resolved by velocity measurements using six scintillation counters. The total K^-–p cross-section measured with good geometry by transmission through a liquid hydrogen target for 0.9 BeV/c mesons is 52 ± 9 mb. At 100 ft from the target the mean lifetime is $(14.9^{+2.3}_{-2.4}) \times 10^{-9}$ sec, the statistical counting error being $\pm 13\%$. K.H.Barker

539.18

6604. LIFETIME OF THE NEUTRAL PION.
G.Harris, J.Orear and S.Taylor.
Phys. Rev., Vol. 106, No. 2, 327-9 (April 15, 1957).

A new upper limit on the π^0 lifetime has been obtained by using 12 $K_{\pi 2}{}^+$ endings in nuclear emulsion where the π^0 decays by a direct pair, $\pi^0 \rightarrow (e^+ + e^-) + \gamma$. The distance travelled by the π^0 before decay was measured from the intersection of the K^+ and π^+ tracks to the intersection of the pair and π^0 (colinear with π^+). The inherent accuracy of the measuring technique was found to be ~ 0.5 micron per event by using τ^+ secondaries as mock events. With the statistics of 12 events it should be possible to detect a π^0 decay length of ~ 0.2 micron or greater. The data give no indication of a displacement of pair origins from the K-endings. Thus the π^0 decay length is probably less than ~ 0.2 microns. This corresponds to a lifetime of less than 5×10^{-16} sec. Information on the upper limit of the π^0 lifetime is obtained from a plot of the likelihood function v. π^0 lifetime. The likelihood function is down by a factor of 30 for a lifetime of 1×10^{-15} sec and is rapidly decreasing for longer lifetimes. A.

539.18

6605. ANGULAR DISTRIBUTIONS OF POSITRONS FROM $\pi^+ - \mu^+ - e^+$ DECAYS OBSERVED IN A LIQUID HYDROGEN BUBBLE CHAMBER. A.Abashian, R.K.Adair, R.Cool, A.Erwin, J.Kopp, L.Leipuner, T.W.Morris, D.C.Rahm, R.R.Rau, A.M.Thorndike, W.L.Whittemore and W.J.Willis.
Phys. Rev., Vol. 105, No. 6, 1927-8 (March 15, 1957).

Magnetically-analysed 100 MeV π^+-mesons were stopped in a hydrogen bubble chamber in a field < 0.25 gauss. The angular distribution over the whole electron momentum spectrum is given by: $dN \propto [1 - (0.25 \pm 0.045)\cos\theta]d\Omega$. The $\pi - \mu$ angles are consistent with spherical symmetry. K.H.Barker

539.18

6606. CONSEQUENCES OF CHARGE INDEPENDENCE FOR THE MAGNETIC MOMENTS AND MASSES OF Σ HYPERONS.
R.Marshak, S.Okubo and G.Sudarshan.
Phys. Rev., Vol. 106, No. 3, 599-603 (May 1, 1957).

This note points out certain results on the magnetic moments and mass differences of the Σ^+, Σ^0, Σ^- hyperons consequent on the postulate of charge independence for strong interactions. A.

539.18

6607. THE PROBLEM OF THE SPIN AND PARITY OF THE τ-MESON. I.S.Shapiro, É.I.Dolinskiĭ and A.P.Mishakova.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 173-5 (1957). In Russian.

Dalitz's plot (Abstr. 7758/1954) is considerably extended by the inclusion of more recent data; even parity and non-zero spin for the τ-meson are now virtually excluded by the statistics. J.W.Gardner

539.18

6608. MESON–NUCLEON SCATTERING PHASES IN THE ENERGY REGION BELOW 310 MeV.
A.I.Mukhin, I.V.Popova and G.N.Tentyukova.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 2, 236-8 (1957). In Russian.

Analyses of angular distributions in the region 130-310 MeV are carried out, both neglecting and taking into account d-phase shifts. The higher energy data appears to require d-phase shifts. G.E.Brown

539.18

6609. A POSSIBLE EXPLANATION OF THE ANOMALOUS SCATTERING OF μ-MESONS. G.N.Fowler.
Nuclear Physics, Vol. 3, No. 1, 121-6 (March, 1957).

The elastic Coulomb scattering cross-section of μ-mesons at large angles is affected by inelastic scattering of the incident μ-mesons when the energy transfer is ≥ 150 MeV. This effect is found to give results which are not inconsistent with the observations on the large angle scattering μ-mesons by lead nuclei if $\sigma_{inel} \cong 4$ mb/nucleus. A.

539.18

6610. INTERFERENCE PHENOMENA OF K^+-MESON SCATTERING BY NUCLEI. D.F.Davis.
Phys. Rev., Vol. 106, No. 4, 816-17 (May 15, 1957).

An analysis of the elastic scatters of K^+-mesons in emulsion shows thas the data favour a repulsive nuclear potential. A description of the analysis of the experimental results is given. A.

539.18

6611. INTERACTION OF K^+-MESON AND NUCLEON. S.Minami.
Progr. theor. Phys., Vol. 16, No. 1, 66-8 (July, 1956).

The ratio of charge exchange to non-charge exchange scattering cross-sections of K^+-mesons is calculated using an interaction Hamiltonian which satisfies the Gell-Mann–Nishijima rule. The ratio is sensitive to the relative parities of hyperons and heavy mesons and may be important in determining the parities of strange particles. J.W.Sturgess

539.18

6612. SCATTERING OF K-MESONS WITH CHANGE OF INTERNAL PARITY. V.B.Berestetskiĭ and Yu.A.Bȳchkov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 181-3 (1957). In Russian.

The scattering formalism is set up and the coefficients in parity space are calculated. The interaction is assumed to be invariant under parity conjugation. G.E.Brown

539.18

6613. RELATION BETWEEN SCATTERING AND ABSORPTION IN THE PAIS–PICCIONI PHENOMENON. M.L.Good.
Phys. Rev., Vol. 106, No. 3, 591-5 (May 1, 1957).

See Abstr. 1614 (1956). The expression for the θ_1 and θ_2 amplitudes in a beam of neutral θ-mesons traversing an absorber are put in terms of forward-scattering amplitudes. It is discovered that a phase-shift term as well as an absorption term is needed to describe the regeneration of θ_1 mesons in the unscattered beam. A simple relation is derived between the intensities of the above process and of the θ_1 mesons regenerated by scattering. Experimental verification of the relation may give additional information about the nature of the neutral K-mesons. A.

539.18

6614. REACTION INDUCED BY μ-MESONS IN HYDROGEN. Ya.B.Zel'dovich.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 3, 493-6 (1954). In Russian.

It is suggested that in the capture of μ-mesons in liquid hydrogen or liquid deuterium (or a mixture of the two) the presence of a μ-meson in the S-state may allow the mesic atom to approach another atom to within a distance at which a nuclear reaction may occur. Therefore, in such a process, the μ-meson, owing to its mass and charge, should play the role of a catalyst. Various possible cases are quantitatively investigated and the results of possible experiments are predicted. For experimental observations see Abstr. 5851 (1957). G.Martelli

539.18

6615. IONIZATION AT THE ORIGIN OF AN ELECTRON PAIR OF VERY HIGH ENERGY. W.Wolter and M.Mięsowicz.
Nuovo Cimento (Ser. 10), Vol. 4, No. 3, 648-50 (Sept., 1956).

Measurements are reported on a single electron pair of very high energy to investigate possible reduction in ionization in the region near the origin of the pair where electron and positron are separated by less than the maximum value of the interaction radius for ionization. A.J.Egginton

539.18

6616. K^+ PRODUCTION IN p–p COLLISIONS AT 3.0 BeV. S.J.Lindenbaum and L.C.L.Yuan.
Phys. Rev., Vol. 105, No. 6, 1931-2 (March 15, 1957).

It was found that positive K-particles were produced directly in proton–proton collisions, using a hydrogen target bombarded with 3.0 BeV protons and a counter telescope to detect the heavy mesons. The ratio of K^+ to π^+ mesons (of momentum 425 MeV/c) produced was $1/(200 \pm 70)$, compared with $1/(80 \pm 12)$ when a copper target was used. This further implies that in proton–nucleus reactions K^+ production does proceed directly through nucleon–nucleon collisions and not only through a two-stage process involving an intermediate pion, as earlier work on the production of neutral strange particles has suggested. J.W.G.Wignall

539.18

6617. ISOBAR MODEL FOR MESON PRODUCTION IN PROTON–PROTON COLLISIONS. S.Barshay.
Phys. Rev., Vol. 106, No. 3, 572-85 (May 1, 1957).

A model is considered for single- and double-pion production in which the production takes place via an intermediate state wherein either one or both of the initial nucleons is excited to the isobaric state of $J = I = \frac{3}{2}$. The treatment is phenomenological and comparison is made with recent experiments in the 0.5 to 1.5 BeV range. Two striking features of the experiments, the strong preference for the emission of mesons with kinetic energies of 50 to 150 MeV, and the rapid increase in the two-meson processes at bombarding energies above 1 BeV, are exhibited by the calculation. A.

539.18

6618. ANGULAR DISTRIBUTION OF PHOTOPIONS FROM DEUTERIUM. D.C.Hagerman, K.M.Crowe and R.M.Friedman.
Phys. Rev., Vol. 106, No. 4, 818-20 (May 15, 1957).

Measurements have been made on the relative cross-section of positive pions made by 350 MeV bremsstrahlung for deuterium and hydrogen for laboratory angles between 30^0 and 90^0. The ratio of the differential cross-sections is essentially a constant to about ±5%. The mean pion laboratory energy of 75 ±5 MeV was held constant for the different angles. The results compare qualitatively with those obtained from Watson's phenomenological theory for photopion production. A.

539.18

6619. ON THE NUCLEAR INTERACTION OF μ-MESON BELOW GROUND. T.Kitamura and M.Oda.
Progr. theor. Phys., Vol. 16, No. 3, 252-4 (Sept., 1956).

The numbers and energy spectra of pions produced by muon interactions at various depths is calculated, and found to be considerable, especially at greater depths; the inference that many of the interactions observed underground are not due to muons, but to these secondary pions, has an important bearing on the determination of the muon interaction cross-section. J.W.G.Wignall

539.181

6620. RESONANCE EXPERIMENTS IN SUCCESSIVE OSCILLATORY FIELDS. N.F.Ramsey.
Rev. sci. Instrum., Vol. 28, No. 1, 57-8 (Jan., 1957).

Points out that the advantage of narrow line-width of the double oscillatory field atomic-beam systems could be obtained in other systems if reflecting container walls could be found which do not affect the energy states of the particles reflected. D.H.Whiffen

539.185 : 548.7

6621. THERMAL INELASTIC SCATTERING OF COLD NEUTRONS IN POLYCRYSTALLINE GRAPHITE. L.S.Kothari and K.S.Singwi.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 314-15 (April, 1957).

A calculation of the variation with temperature (0-1000°K) of the cross-section for 10 A neutrons gives values in good agreement with unpublished results. The model used takes into account the anisotropic nature of the graphite lattice. E.J.Burge

539.185

6622. TOWARDS A THEORY OF NEUTRON MODERATION. A.Ya.Temkin.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 893-5 (1956). In Russian.

Discusses the integration of the neutron transport equation when it contains both elastic and inelastic scattering terms. By use of suitably defined operator a series solution is obtained which is then compared with the conventional approximations. J.W.Gardner

539.185

6623. A NEW METHOD FOR MEASUREMENT OF MEDIUM-ENERGY NEUTRON POLARIZATION AND PHASE ANALYSIS OF n–He^4 SCATTERING. I.I.Levintov, A.V.Miller and V.N.Shamshev.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 274-83 (1957). In Russian.

A helium analyser for measurement of neutron polarization in the 1-18 MeV energy region is described. The efficiency of the analyser in this region approaches 100%. The sensitivity of the instrument is approximately 20 counts/min for a neutron flux of 10^5 neutrons/cm^2 sec. The instrument operates practically without any background. The azimuthal asymmetry of 2.45 and 3.5 MeV (D + D) neutrons scattered on He^4 has been measured. Analysis of the results confirms the experimental phase-shift values obtained by Seagrave (1953) and contradicts the phase-shift values obtained by Huber and Baldinger (1952). A.

539.185 : 537.13 : 530.145

ANOMALOUS MAGNETIC MOMENTS OF NUCLEONS.
See Abstr. 5839

539.185.08

6624. NEUTRON ENERGY MEASUREMENTS WITH DOUBLE PULSE SCINTILLATION COUNTERS. P.T.Andrews.
Rev. sci. Instrum., Vol. 28, No. 1, 56 (Jan., 1957).

The fast neutron detector of Reines et al.(Abstr. 2225/1955) uses delayed coincidence between recoil and capture light pulses in an organic scintillator. It is shown that the size of the recoil pulse cannot give a clear value of energy because of phosphor non-linearity and neutron–carbon collision. The problem is analysed and it is shown that the uncertainty of energy measurement increases with neutron energy. G.F.J.Garlick

539.185.08

6625. MEDIUM-ENERGY NEUTRON TIME-OF-FLIGHT SPECTROMETER. R.Grismore and W.C.Parkinson.
Rev. sci. Instrum., Vol. 28, No. 4, 245-53 (April, 1957).

A neutron time-of-flight spectrometer developed for the 1 to 20 MeV region is described. The instrument makes use of the phase bunching of deuterons in the Michigan 42 in. cyclotron and an external beam pulsing system to provide isolated bursts of neutrons of 4 mμsec time duration. Flight times are measured with an improved version of the chronotron capable of a precision of $\pm 3 \times 10^{-10}$ sec. The energy spread for a 5 metre flight path varies from 3.5% at 0.5

MeV to 10% at 20 MeV. The available neutron flux permits an improvement of at least a factor of three by lengthening the flight path. The $Be^{9}(d,n)$ thick target and the $O^{16}(d,n)$ thin target spectra are discussed. A.

539.185.08 : 537.542

SLOW-NEUTRON DETECTION IN PRESENCE OF GAMMA-RADIATION. See Abstr. 6296

539.185.9 : 536.483

6626. TECHNIQUES AND EQUIPMENT UTILIZED IN LOW-TEMPERATURE REACTOR IRRADIATIONS.
R.R.Coltman, T.H.Blewitt and T.S.Noggle.
Rev. sci. Instrum., Vol. 28, No. 3, 375-80 (May, 1957).

A cryostat used in the graphite reactor at Oak Ridge National Laboratory is described in detail. The cryostat which is made almost entirely of aluminium is supplied with cold helium gas from a helium refrigerator. Bombardments have been made in the cryostat at temperatures as low as 15°K for periods as long as two weeks. A discussion of the equilibrium temperature attained by a specimen in the cryostat is given taking into account the reactor gamma-ray heating effects. A method for measuring stored energy and specific heats of materials bombarded in the cryostat utilizing gamma-ray heating is described. A method for pulse annealing specimens at low temperatures employing the discharge of the energy stored in a bank of condensers is also described. Relatively sharp and quite reproducible thermal pulses can be obtained with this method (which is also suitable for use in the laboratory). The hazard of cryogenic devices in high radiation fields is discussed. It is believed that when air is allowed to condense on a cold surface in the presence of intense ionizing radiations, a hazardous condition results. A.

STRUCTURE OF SOLIDS 539.2

539.21 : 539.213.2

6627. THE COLOURS PRODUCED IN GLASSES BY EXPOSURE TO RADIATIONS. P.L.Baynton and H.Moore.
J. Soc. Glass Technol., Vol. 40, 187T-251T (June, 1956).

The coloration produced in various series of glasses by exposure to ultraviolet radiation and to X-radiation of high energy has been studied. The "radiation colours" which develop in glasses containing iron or manganese are consistent with the generally accepted modern view that the coloration is of two types, caused by absorption resulting from (i) increase of valency of some consituent ion or ions which can exist in two or more valency states, and (ii) the displacement of electrons from ions in the glass to sites where an anion is missing from the glass structure. The effects of arsenic, titanium, and cerium, alone or present together, on the development of ferric iron colour in glasses which contained small amounts of iron were studied, and also the effects of arsenic on the development of the purple manganese colour in glasses containing manganese in small proportions. Most of the work was done on soda–lime–silica glasses, but observations were also made on a series of alkali–lead–silica glasses and on a few borosilicate and boro-aluminate glasses. A study was made, of the marked fading of the "radiation colour", which was found to occur when the irradiated glasses were kept in the dark at room temperature. The observations on the fading suggested further work on a series of binary soda-silica glasses, and out of this work certain conclusions were tentatively drawn concerning the types of vacant sites in which electrons may be trapped in the structure of silicate glasses. Observations on a binary lime-silica glass, of a composition "equivalent" to that of a binary soda-silica glass of high soda content, suggest strongly that the Ca^{2+} ion has an appreciable bonding action in the glass structure. A.

539.211

6628. KINETICS OF SLOW FRACTURES IN GLASS.
W.C.Levengood and W.H.Johnston.
J. chem. Phys., Vol. 26, No. 5, 1184-5 (May, 1957).

Fractures in plate glass, originating at a cutter mark and progressing slowly parallel to the surface, were observed under controlled conditions. The rates of spread of such fractures, immediately after the glass is cut and for several hours afterward, were determined by viewing microscopically the movement of interference fringes produced in monochromatic light. Effects of external atmosphere, and of various included gases introduced during melting, are described. A theory of the kinetics of slow fracture rates is offered, which relates the fracture spreading rate to the molecular diameter and molecular weight of the internal gas involved. A.

539.21

6629. OPTICAL CONTACT OF POLISHED GLASS SURFACES.
I.V.Obreimov and E.S.Trekhov.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 185-93 (1957). In Russian.

It is shown that the specific work required to separate two surfaces in optical contact is a fairly constant quantity and that the forces between the two surfaces act at very small distances of the order of 10^{-7} cm. A

539.213.1 : 535.551

THE EFFECTS OF THE POLARIZATION OF THE CONSTITUENT IONS ON THE PHOTOELASTIC BIREFRINGENCE OF THE GLASS. See Abstr. 6077

539.215.9 : 532.582.2

6630. THE FLOW OF COHESIONLESS GRAINS IN FLUIDS.
R.A.Bagnold.
Phil. Trans A, Vol. 249, No. 964, 235-97 (1956).

A semi-empirical analysis is given of the state of stress, and the characteristics of the flow, in a dispersion of solid grains in a fluid (wind or water) flowing over a gravity bed of similar grains. Both laminar and turbulent flow are included. Conditions at the bed surface are examined theoretically, in particular the conditions under which instability of the surface occurs, with consequent erosion, the formation of primary or secondary ripples, and the growth of dunes. The drag on individual grains and the transport rate of fluid-driven grains are estimated. Quantitative deductions are based on earlier measurements of stresses in concentrated suspensions of grains in a liquid flowing between rotating coaxial drums. These are in reasonably good agreement with the available results of observation of the formation and disappearance of bed features, saltation, transport rates, etc. J.G.Oldroyd

539.21

6631. ON THE ENERGY OF ACTIVATION FOR SELF-DIFFUSION IN METALS. G.Borelius.
Ark. Fys., Vol. 11, Paper 16, 259-63 (1956).

It is postulated that the elementary step in metallic self-diffusion is a thermal fluctuation in density, which leads to the transitory formation of a hole big enough that a neighbouring atom may jump into it; the fluctuation then subsides and the atoms again assume normal sites, which may differ from those occupied originally. The hole volume is taken equal to the ion core volume and the ratio of activation energy to hole volume is assumed equal to the rate of change of lattice potential energy with lattice volume. On the basis of these assumptions the activation energy for diffusion is then calculated from thermodynamic data for Li, Na, W, Cu, Ag, Au and Pb; agreement with experiment is very good. A.B.Lidiard

539.21

6632. HYDROGEN PERMEATION THROUGH STEEL DURING ABRASION. R.C.Frank and D.E.Swets.
J. appl. Phys., Vol. 28, No. 3, 380 (March, 1957).

If a cylinder of SAE 4340 steel, wall thickness 0.020 in. is maintained at 70°C and rubbed with dry abrasive paper, hydrogen permeates through the steel; this is attributed to atmospheric water vapour. If the paper is wet there is a faster permeation, and if wet with D_2O there is permeation of D_2. N.Corcoran

539.21

6633. SELF-DIFFUSION IN SOLID METHANE. J.S.Waugh.
J. chem. Phys., Vol. 26, No. 4, 966-7 (April, 1957).

Previous results on proton resonance line widths (Abstr. 2899/1951) are interpreted using the theory of diffusional narrowing. The diffusion constant of methane molecules is inferred to be $D = (7 \times 10^{-6}) \exp(-1500/RT)$ cm²/sec where R is the gas constant in cals/deg K. g mole. A.B.Lidiard

539.21

6634. SURFACE MIGRATION OF TUNGSTEN ATOMS IN AN ELECTRICAL FIELD. I.L.Sokol'skaya.
Zh. tekh. Fiz., Vol. 26, No. 6, 1177-84 (1956). In Russian.

The apparatus used was the conventional spherical projector 8 cm dia. with a tungsten point, the anode being an "Aquadag" layer on glass. The fluorescent screen was obtained by coating a wetted bulb surface with willemite without using any binder. The rates of the structure-transition and smoothing processes were determined as the reciprocals of the times of the transitions. It was found that these processes can be characterized quantitatively by changes in the field-emission current at fixed potential, the time of the complete structural transition being determined as that in which the current attains a constant value. The structure-transition process

does not depend on the field sign; hence the metals whose atoms migrate on the metal surface in an electrical field can be treated as dipoles moving along potential gradients. The structure transition in a field of the opposite sign makes it possible to protect the point against ionic bombardment and to carry out the experiments in very strong fields without causing the point to be melted by the electronic current. The energy of activation of the structure transition and the smoothing process were determined to be 2.36 and 3.2 eV, respectively. The obtained data, when interpreted in accordance with the theories of Frenkel (Zh. éksper. teor. Fiz., Vol. 16, 39, 1946) and Stranski and Suhrmann (Abstr. 1575-6/1948) yield values of interaction between two adjacent W atoms in the crystal lattice, which agree well with those obtained from the heat of evaporation. F.Lachman

539.219 : 537.311.31 : 536.6

6635. RESISTOMETRIC AND CALORIMETRIC STUDIES ON THE PRECIPITATION IN ALUMINIUM–SILVER ALLOYS. G.Borelius and L.E.Larsson.
Ark. Fys., Vol. 11, Paper 6, 137-63 (1956).

Reports results of measurements of the electrical resistance and the evolution of heat over the whole composition range and at temperatures between room temperature and about 600° C. The results are related to the details of the phase diagram and of the mechanism of precipitation. E.P.Wohlfarth

539.219 : 548.736.3

6636. METALLOGRAPHIC AND X-RAY INVESTIGATION OF ALLOYS OF THE GERMANIUM–RHODIUM SYSTEM. N.N.Zhuravlev and G.S.Zhdanov.
Kristallografiya, Vol. 1, No. 2, 205-8 (1956). In Russian.

Four compounds were found: Rh_3Ge_4, RhGe, Rh_5Ge_3, and Rh_2Ge. The density and microhardness of each was measured. Rh_3Ge_4 was identified as tetragonal with a = 5.7 ± 0.2 A, c = 10 ± 0.3 A. (See also Geller, Acta cryst., Vol. 8, 15, 1955). R.F.S.Hearmon

539.219.2

6637. THEORY OF THERMAL GROOVING. W.W.Mullins.
J. appl. Phys., Vol. 28, No. 3, 333-9 (March, 1957).

A theory is presented which describes the development of surface grooves at the grain boundaries of a heated polycrystal. The mechanisms of evaporation–condensation and surface diffusion are discussed with the use of the Gibbs–Thompson formula and the assumption that the properties of an interface do not depend on its orientation. For the idealized case in which only one of the mechanisms is operative, the groove profile is shown to have a time-independent shape whose linear dimensions are proportional to $t^{\frac{1}{3}}$ for evaporation–condensation, and to $t^{\frac{1}{4}}$ for surface diffusion. The proportionality constants are evaluated, and criteria are developed which permit one to estimate which process predominates in practice. Order of magnitude agreement is obtained with estimates of actual grooving speeds and profiles. A.

539.23 : 535.514 : 535.393

METAL FILM OPTICS. See Abstr. 6054

539.234

6638. MEASUREMENT OF THE DISLOCATION ENERGY OF BISMUTH AND GALLIUM LAYERS AT LOW TEMPERATURES. W.Sander.
Z. Phys., Vol. 147, No. 3, 361-72 (1957). In German.

Bismuth and gallium layers have been examined. These exist in a disordered state after quenching and condensation and, when heated, crystallize in one or two transitions respectively. It is found that the heat of transition for bismuth is 1.45 kcal/mol and for gallium 0.29 kcal/mol and 0.58 kcal/mol. The respective changes of resistance are found to run parallel to the heat development. The activation energy for the Bi transition is estimated as 0.04 eV. E.W.Kellermann

539.27

6639. STUDY WITH THE CHEVENARD THERMOBALANCE AND THE ELECTRON MICROSCOPE OF MAGNESIA CARBONATED AND HYDRATED BY MOIST AIR. D.Blet-Talbot.
Cahiers de Phys., No. 75-76, 33-8 (Nov.-Dec., 1956). In French.

The author's previous findings (Abstr. 4349/1956) on the changes in the scattering of light by magnesia are explained by the change in shape of the particles from cubic to spherical when H_2O and CO_2 are absorbed from the atmosphere. On heating to about 350° C the magnesia is restored to its original weight and particle shape. G.F.Lothian

ELASTICITY. STRENGTH. RHEOLOGY

539.3/.8

539.312

6640. LOW-FREQUENCY DYNAMIC MODULUS OF AN ACRYLONITRILE-BUTADIENE RUBBER. A.R.Payne.
J. appl. Phys., Vol. 28, No. 3, 378-9 (March, 1957).

The low-frequency dynamic data of Hutton and Nolle (Abstr. 5040/1954) for a vulcanized Buna-N rubber are analysed by the "method of reduced variables". The relationship between complex compliance, frequency and temperature, is of the same form as for many other high polymers, and there is no evidence of a cross-linking structure affecting the mechanical properties sufficiently to invalidate the method of analysis. J.G.Oldroyd

539.32 : 536.413

6641. FAST NEUTRON IRRADIATION EFFECTS ON CERTAIN PHYSICAL CONSTANTS OF CRYSTALLINE QUARTZ AND VITREOUS SILICA. G.Mayer and J.Gigon.
J. Phys. Radium, Vol. 18, No. 2, 109-14 (Feb., 1957). In French.

Values of elastic constants and coefficients of thermal expansion between −190° C and 0° C were measured for quartz and silica irradiated to a dose of 22 x 10^{18} neutrons. cm^{-2} in a "neutron converter" in the Saclay pile. A 15% decrease in the heat of transformation at the $\alpha \rightarrow \beta$ change point and a lowering by about 6 deg. of the transformation temperature were found in a sample of crystalline quartz irradiated to a dose of 5 x 10^{18} neutrons. cm^{-2}. J.Adam

539.32

6642. DYNAMIC MECHANICAL PROPERTIES OF POLYETHYLENE AND POLYTETRAFLUOROETHYLENE. S.P.Kabin.
Zh. tekh. Fiz., Vol. 26, No. 12, 2628-32 (1956). In Russian.

The substances are studied using longitudinal vibrations at frequencies of 0.5, 1.0, 2.0, 3.5, 5.0 Mc/s at temperatures from −115° C to +80° C for polyethylene and from −65° C to +20° C for polytetrafluoroethylene. Mechanical and dielectric losses for crystalline and amorphous polymers may be accounted for by similar relaxation times and activation energies. M.W.Makowski

539.32.08 : 534.321.9

6643. DETERMINATION OF THE ELASTIC CONSTANTS OF ICE SINGLE CRYSTALS BY AN ULTRASONIC PULSE METHOD. R.E.Green, Jr and L.Mackinnon.
J. Acoust. Soc. Amer. Vol. 28, No. 6, 1292 (Nov., 1956).

The method involves the direct measurement of the velocities of longitudinal and shear pulses along the c (optic) axis of the crystal. The results show fair agreement with the Jona and Scherrer values (Abstr. 3920/1952) and confirm the conclusion that Penny's (Abstr. 2603/1948) theoretical values are generally too high. The accuracy of the present method is estimated to be 2%. A.J.Kennedy

539.32.08 : 534.121.1

6644. ON THE MEASUREMENT OF ELASTIC CONSTANTS OF CRYSTALS FROM THE NATURAL FREQUENCIES OF THICK PLATES OR WITH THE HELP OF THE SCHAEFER–BERGMANN TECHNIQUE. S.Haussühl.
Naturwissenschaften, Vol. 43, No. 17, 394-5 (1956). In German.

A method has been devised of eliminating, or greatly reducing, the main sources of error in the wedge technique of Bhagavantam and in the Schaefer–Bergmann technique (notably temperature variations in the specimen and orientation errors) in measuring the elastic constants of alkali halides of the rocksalt type. The refinements include optically perfect grinding of the parallel plane faces of the crystal whose principal frequencies are to be measured. Wave velocities, which are highly sensitive to changes of orientation, can be measured with a proportional error less than 1%. J.G.Oldroyd

539.374

6645. DYNAMIC MECHANICAL PROPERTIES OF POLY-HEXENE-1. S.F.Kurath, E.Passaglia and R.Pariser.
J. appl. Phys., Vol. 28, No. 4, 499-502 (April, 1957).

A double electromagnetic transducer has been used to evaluate the complex shear modulus of polyhexene-1 from +70° C to −27.5° C in the 25 to 2500 c/s frequency range. Real and imaginary components of the complex shear modulus as well as the mechanical loss tangent are reported over nine decades of reduced frequency. The

temperature dependence of mechanical properties is discussed in terms of polymer-free volume and the glass transition temperature of −55°C. The shape of the relaxation distribution function in the transition region is similar to that of polyisobutylene. In the rubbery region the distribution function obtained from dynamic shear moduli compares favourably with that determined from stress relaxation measurements. A.

539.374.08

6646. ON THE MEASUREMENT OF MACROSTRESSES BY THE X-RAY METHOD OF ANGLE PHOTOGRAPHS. D.M.Vasil'ev.
Zh. tekh. Fiz., Vol. 26, No. 10, 2389-95 (1956). In Russian.

The method is applied to the measurement of residual stresses in plastically deformed specimens. R.F.S.Hearmon

539.42

6647. RELATIONSHIP BETWEEN THE FRACTURE DUCTILITY TRANSITION AND STRAIN HARDENING CHARACTERISTICS OF A LOW CARBON STEEL. J.M.Krafft, A.M.Sullivan and G.R.Irwin.
J. appl. Phys., Vol. 28, No. 3, 379-80 (March, 1957).

The strain-hardening is given by the index n in the equation $\sigma = \kappa\delta^n$ where σ and δ are true stress and true strain and κ a constant. The tests reported impose high speed compression upon cylindrical specimens, using a Hopkinson bar technique, at temperatures from −70°C to 120°C with maximum strain rates ranging from 50 to 500 sec^{-1}. Values of n, of flow stress, and of the tangent modulus (derived from plastic propagation formula), each plotted against temperature, all yield curves of the same form. It is suggested that temperature-dependence of the brittle fracture of low carbon steels may be interpreted in terms of these strain hardening characteristics. A.J.Kennedy

539.42 : 539.217.1

6648. SOME REGULARITIES OF MECHANICAL PROPERTIES IN SPECIMENS OBTAINED FROM METALLIC POWDERS BY SINTERING. I. B.Ya.Pines and N.I.Sukhinin.
Zh. tekh. Fiz., Vol. 26, No. 9, 2076-85 (1956). In Russian.

When trying to investigate systematically the laws governing the mechanical strength in the one- and two-component sintered mixtures of metal powders, the basic metal being always Cu, it was found that: (1) the tensile strength p in single-phase pressings fired for different times at the same temperature decreased linearly as porosity increased, (2) p depended also on the sintering temperature, (3) the slope of the p/porosity line was greater in Cu samples sintered at 1000°C than in those sintered at lower temperatures, and (4) the strength values extrapolated to zero porosity depended on the concentrations by volume σ and $1-\sigma$ according to the formula $p = p_1(1-\sigma)^2 + p_2\sigma^2 + 2p_{12}\sigma(1-\sigma)$. F.Lachman

539.42 : 539.217.1

6649. SOME REGULARITIES OF MECHANICAL PROPERTIES IN SPECIMENS OBTAINED FROM METALLIC POWDERS BY SINTERING. II. B.Ya.Pines and A.F.Sirenko.
Zh. tekh. Fiz., Vol. 26, No. 10, 2378-86 (1956). In Russian.

For Pt I, see preceding abstract. Powder pressings pre-fired at 1000°C were tested for tensile strength (p) in a H_2 atmosphere at temperatures up to 900°C, the ratio of the loading-rate extremes being 1/100. Linear relationship between the logarithm of the loading rate and p (cf. Zhurkov and Narzulaev, Zh. tekh. Fiz., Vol. 23, 1677, 1953) was confirmed for specimens with the same porosity. When the specimens were of different porosity, the tests at high temperatures and constant loading rate showed that p fell linearly as the porosity increased; this applied not only to the one-component specimens, but also to the Cu–Fe and Cu–Ni mixtures. The formula developed in Pt I was found to be right for temperatures 800-900°C. The elongations up to failure were smaller in porous single-phase specimens than in solid specimens; for mixtures they were smaller than those calculated on the basis of additivity; the linear relationship between elongation and porosity was found to exist at high temperatures, too. F.Lachman

539.431 : 621.372.412 : 620.178.3

6650. ON A NEW METHOD OF APPLYING SINUSOIDAL FATIGUE STRESSES AT 87 kc/s. G.Vidal and F.Girard.
C.R. Acad. Sci. (Paris), Vol. 243, No. 18, 1276-8 (Oct. 29, 1956). In French.

The method is an extension of that described in Abstr. 4706 (1956). A barium titanate crystal in the form of a tube is set in longitudinal resonance by an oscillator. A disk rests on one end of the tube, and this is attached to the middle section of the cylindrical test specimen. The disk is pressed against the end face of the crystal tube by a rubber washer and by a clamp fixed to the middle section of the crystal. The test-piece is cut to a resonant length, oscillation being maintained by a pick-up driven by the motion of the upper end of the test-piece. A number of alloys and non-metals have been tested to failure by the apparatus. A.J.Kennedy

539.43

6651. THE NATURE OF PERSISTENT SLIP BANDS IN FATIGUED COPPER. D.S.Kemsley.
Phil. Mag. (Eighth Ser.), Vol. 2, 131-2 (Jan., 1957).

In rotating cantilever fatigue tests on annealed high-conductivi Cu, persistent slip bands (see Abstr. 5051/1954, 2483/1956) are observed only when a specimen is electrolytically polished early in its fatigue life, and then only in the case of low-stress cycling (±10 000 lb/in² at 6000 c/min). It is suggested that certain surface striations are subject to rapid attack during electrolytic polishing soon after their formation, so that grooves are formed which then give rise to stress concentration and hence to fatigue cracks. J.G.Oldroyd

539.43

6652. SOME OBSERVATIONS ON THE NATURE OF FATIGUE DAMAGE. P.J.E.Forsyth.
Phil. Mag. (Eighth Ser.), Vol. 2, 437-40 (April, 1957).

Damage in an Al–Zn–Mg alloy occurs as persistent bands containing rows of holes, apparently in the form of tubes penetrating to different depths. Mechanical polishing reveals the holes, but not the bands. Electrolytic polishing reveals both, the bands appearing as grooves. No marked bands appear in pure aluminium or in heat-treated alloy. Probably therefore the holes are voids occurring along the slip planes, whereas the bands contain higher concentrations of solute atoms, which are electrolytically polished more rapidly than the matrix, thus producing grooves. R.C.Kell

539.434

6653. WORK RELAXATION OF CRYSTALS OF CADMIUM, ZINC AND ALUMINIUM FORMED FROM MOLTEN MATERIALS.
F.Blaha, S.Marinelli and E.Schmid.
Acta phys. Austriaca, Vol. 11, No. 1, 23-30 (1957). In German.

A Polanyi-type machine was used for creep tests on crystals of Al, Cd and Zn, each specimen being 0.2-0.5 mm in dia. and 12-14 mm long. Each specimen was subjected to two loading cycles consisting of (1) initial strain at a low temperature, T_0, giving very small strain and (2) a full creep test at a higher temperature, T_1, with load held constant for 45 to 90 sec, then a rest for 2 min with load removed, followed by a second similar test at T_1. In all but two series of tests, this cycle of loading was repeated again with an additional intermediate strain test at the temperature T_1. Higher values of this additional straining at the higher temperature increased the subsequent creep strain, but too small an initial low temperature strain tended to minimize the effect. With Al, there seemed to be an effective limit at about 0.2% strain. The additional strain intermediate between the two creep cycles had to be of a definite size, otherwise no relaxation occurred. A.C.Whiffin

539.434

6654. CREEP OF ALUMINIUM UNDER DYNAMIC LOAD.
A.A.Predvoditelev and B.A.Smirnov.
Vestnik Moskov. Univ., No. 3, 51-5 (1956). In Russian.

Little attention has as yet been given to the problem of creep measurement under alternating load. The main difficulty is that of measuring the strain; the well-tried methods for use under constant load conditions are not suitable for vibrating apparatus. An apparatus is described in which the specimen can be given a heat treatment, studied at various temperatures, given a steady load and subjected to an additional load varying at 50 c/s. Studies with aluminium appear to show: (a) creep increases sharply under pulsed shock loading; (b) the curve of dynamic creep similar to that under constant load; (c) slip processes in the metal are intensified under dynamic load. C.R.S.Manders

539.434 : 538.65 : 538.24

PLASTIC BEHAVIOUR OF MAGNETIZED NICKEL CRYSTALS. See Abstr. 6350

539.89 : 535.32

RELAXATION EFFECTS IN GLASS FOLLOWING REMOVAL OF HIGH HYDROSTATIC PRESSURE. See Abstr. 5970

539.89

6655. SOME INVESTIGATIONS ON THE DYNAMIC COMPRESSION OF A SUBSTANCE. Yu.N.Ryabinin.
Zh. tekh. Fiz., Vol. 26, No. 12, 2661-6 (1956). In Russian.

Compression produced using explosives permits realization of pressures of hundreds of thousands of atmospheres. Investigations show that a rapid compression and expansion results in some substances in irreversible changes. An attempt to obtain diamond from graphite using this method proved unsuccessful. Z.Krasuck

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.126

6656. ON THE THEORY OF EXPLOSIVE PROCESSES.
N.S.Akulov.
Dokl. Akad. Nauk SSSR, Vol. 104, No. 3, 376-9 (1955). In Russian.

The instantaneous concentrations of the participating constituents in an explosive process are designated by a collection of stochastic variables for which diffusion equations can be set up. Series solutions are proposed for these equations; each series describes a chain reaction whose violence is directly related to the divergence.
J.W.Gardner

541.127

6657. INTEGRATED RATE EQUATIONS FOR ISOTOPIC EXCHANGE IN SIMPLE REVERSIBLE REACTIONS.
R.A.Alberty and W.G.Miller.
J. chem. Phys., Vol. 26, No. 5, 1231-7 (May, 1957).

The integrated rate equations are given for various mechanisms by which three substances may be interconverted by first-order reactions. These equations are of special interest in the interpretation of isotopic exchange in the presence of an over-all chemical reaction. When certain rate constants in the mechanism are equal or have the same ratio as the ratio of concentrations of isotopic species in the reaction medium, considerable simplification of the integrated rate equation occurs. A.

541.127 : 548.7

6658. ON REACTION IN THE SOLID STATE.
G.I.Finch and K.P.Sinha.
Proc. Roy. Soc. A, Vol. 239, 145-53 (Feb. 26, 1957).

Using the concept of phonon–lattice interaction, an expression is derived for the minimum temperature, T_R, of a solid at which it may enter into solid-state reaction. This expression leads to a more precise idea of single-component reaction (sintering) temperatures that those given by Hüttig. Reaction between two different solids has been re-examined in the light of their physical and crystallographic properties. The rate law for such an additive reaction has been deduced from the quantum rate theory. It is concluded that crystallographic phase transformations and the formation of transitional superstructures constitute the phase-boundary processes and that the kinetics are governed by the dynamics of the diffusion process. A.

541.127 : 536.23

HEAT TRANSFER IN CHEMICALLY REACTING MIXTURES.
See Abstr. 6096

541.127.3

6659. EFFECT OF PRESSURE ON THE ISOTOPE EFFECT IN A UNIMOLECULAR GASEOUS REACTION: TRITIUM AND CARBON-13 EFFECTS IN THE ISOMERIZATION OF CYCLOPROPANE.
R.E.Weston, Jr.
J. chem. Phys., Vol. 26, No. 5, 975-83 (May, 1957).

As a new means of studying the effect of pressure on unimolecular gaseous reaction kinetics, the tritium isotope effect in the isomerization of cyclopropane to propylene has been measured. At a pressure of 200 mm, the ratio of rate constants for unlabelled and singly-labelled species is given by $k/k' = (0.86 \pm 0.06)\exp(385 \pm 95/RT)$. The temperature range was 406-492°C. As the pressure decreases, the isotope effect is lowered and, within experimental error, disappears at 1 mm. Upon the addition of inert gas to cyclopropane at this pressure, the isotope effect is increased to a value corresponding to a higher pressure of reactant. The relation between these results and the calculations of Slater on the kinetics of this reaction is discussed. The C^{13} isotope effect was measured at 1 atm and 492°, and was found to be $k/k' = 1.0072 \pm 0.0006$. This may be explained on the basis of a change in either a carbon–carbon or a carbon–hydrogen bond in the transition state. A.

541.127.4

6660. THE COMPLEXES OF PYRROLE. DETERMINATION OF SOME EQUILIBRIUM CONSTANTS BY INFRARED SPECTROSCOPY.
P.Pineau, M.Paty and M.L.Josien.
Cahiers de Phys., No. 73, 36-7 (Sept., 1956). In French.

The value of the polymerization constant of pyrrole in solution in CCl_4, as determined by infrared spectroscopy, is 0.85. The large difference between this value and the previously recorded value of 5.5 obtained by a cryometric method is attributed to the effect of temperature, solvent, and to the physical state of the solutions. The equilibrium constant in the formation of the pyrrole–mesitylene complex has also been determined. G.I.W.Llewelyn

541.128

6661. KINETICS OF THE NITROGEN DIOXIDE CATALYZED OXIDATION OF NITRIC OXIDE. J.D.Ray and R.A.Ogg, Jr.
J. chem. Phys., Vol. 26, No. 5, 984-8 (May, 1957).

The rate constant for the reverse reaction of the rate controlling step ($NO+O_2+NO_2=NO_2+NO_3$) of high-pressure nitrogen pentoxide decomposition has been determined to be 6.58×10^7 cc^2 mole^{-2} sec^{-1}. This reaction was found to be the rate-controlling step in the nitrogen dioxide catalyzed oxidation of nitrosyl chloride to nitryl chloride. The equilibrium constant at 25° for the reaction $ClNO+NO_2=ClNO_2+NO$ as evaluated from the kinetic data was found to be 1×10^{-4}. A.

541.128 : 537.533.2

ON THE PROBLEM OF ELECTRON EMISSION FROM CATALYSTS.
See Abstr. 6253

ELECTROCHEMISTRY 541.13

541.132

6662. ON THE INTERPRETATION OF THE ELECTRON SPIN RESONANCE SPECTRA OF SOLUTIONS OF HYDROCARBONS IN SULFURIC ACID. S.I.Weissman, E.de Boer and J.J.Conradi.
J. chem. Phys., Vol. 26, No. 4, 963-4 (April, 1957).

Dilute solutions of anthracene, tetracene and perylene in conc. sulphuric acid show electron spin resonance absorption, the spectra resembling those of the corresponding hydrocarbon negative ions. The spin resonance spectra of paramagnetic crystalline complexes produced by reaction of the hydrocarbons in CCl_4 with antimony pentachloride suggests that singly charged positive ions are responsible for at least part of the observed paramagnetism.
R.C.Seymour

541.133.08

6663. CONDUCTANCE APPARATUS FOR USE WITH UNPLATINIZED ELECTRODES. H.B.Thompson and M.T.Rogers.
Rev. sci. Instrum., Vol. 27, No. 12, 1079-80 (Dec., 1956).

The circuit features (described in detail) are found to be successful with platinized and with unplatinized electrodes. The bridge could be balanced to within 0.01% or better. W.Good

541.135 : 539.155.2

ELECTROLYTIC SEPARATION OF HYDROGEN ISOTOPES.
See Abstr. 6480

541.135.5

6664. U-EFFECT-III; EFFECT OF LIQUID DROP MOTION IN MERCURY–ELECTROLYTE CAPILLARY TUBES.
B.Podolsky, G.Kushevics and J.L.Rivers.
J. appl. Phys., Vol. 28, No. 3, 357-62 (March, 1957).

When a glass capillary tube filled with alternating drops of mercury and electrolyte is made to vibrate mechanically, an alternating voltage is available across terminals inserted in its ends. This effect has been attributed to changes in the surface area of the interfaces (Yeager and Hovorka, Abstr. 5747/1953). New experimental evidence indicates that at low frequencies the output voltage depends on motion of the liquid drops with respect to the capillary tube. A first-order approximation theory which takes into account the tube compliance and the relative motion of the liquid drops with respect to the capillary tube has been obtained and is found to agree qualitatively with the experimental data relating: (1) tube output voltage to

frequency at fixed amplitude of vibration; (2) tube output voltage to relative motion of the drops at fixed frequency; and (3) short-circuit current output to relative motion for fixed capillary radius, independent of mercury–electrolyte proportions for a given electrolyte. Theory indicates that the voltage is a function of the length of mercury in a tube rather than of the number of interfaces; this result seems to be in agreement with the data. A.

PHOTOCHEMISTRY.

RADIATION CHEMISTRY 541.14/.15

541.144.8

6665. HIGH-INTENSITY FLASH IRRADIATION OF POLYMERS. J.L.Lundberg and L.S.Nelson.
Nature (London), Vol. 179, 367-8 (Feb. 16, 1957).

High intensity flash discharge lamps are used to shorten exposures in u.v. irradiation of polymers. Some homogeneous photolysis occurred but in addition a single flash caused violent heterogeneous decomposition usually accompanied by the formation of gas bubbles and carbon spots within the polymer. Detailed results are given for polyethylene. The decomposition can be prevented by scrupulous exclusion of impurities from the polymer. G.Allen

541.15

6666. ALPHA INDUCED DECOMPOSITION OF AMMONIA. II. EFFECTS OF VARIATIONS IN INTENSITY AND PRESSURE. B.P.Burtt and A.B.Zahlan.
J. chem. Phys., Vol. 26, No. 4, 846-50 (April, 1957).

For previous work, see Abstr. 5048 (1955). The alpha-induced decomposition of ammonia was studied as a function of pressure (70-740 mm) and intensity. The ion yield was found to increase both with increasing intensity and decreasing pressure. The variation with intensity was more pronounced below 200 mm that at higher pressures. Several models were examined to account for the experimental results. The decrease in the yield with increasing pressure was due to the deactivation of HN_3^* generated by the reaction $NH_2 + \rightarrow NH_3^*$. At all intensities used in this work, gas phase ion recombination was negligible. The positive ions were assumed to react with NH_3 to form NH_4^+ which was neutralized at the wall. At sufficiently high pressure and intensity, the NH_2 radicals reacted homogenously in the gas phase, but at low pressure and intensity, wall reactions became important. This "intensity" effect was caused by the ions and does not appear in photolysis. The ion–molecule reactions generate the NH_4^+, the pressure controls the diffusion process, and the intensity determines the relative importance of the gas phase and the wall reactions. The intensity effect is a function of all four variables. On the basis of the reaction scheme and the present knowledge of the mass spectrum, it was possible to calculate a lower limit for the ion yield. A.

541.15

6667. ELECTRON AND γ-RAY RADIOLYSIS OF n-HEXANE. H.A.Dewhurst and E.H.Winslow.
J. chem. Phys., Vol. 26, No. 4, 969-70 (April, 1957).

Liquid n-hexane was irradiated with 800 kV electrons at a dose-rate of 8.7×10^{20} eV g^{-1} min^{-1} and with Co^{60} γ-radiation at a dose-rate of 2.2×10^{17} eV g^{-1} min^{-1}. The total doses delivered were similar, 5.8×10^{21} eV/g for the electron beam and 6.8×10^{21} eV/g for the γ-source. There was a quantitative difference in the relative amounts of the radiation products, which were measured by gas chromatography. The product ratios were different, which is caused by a difference in the yield of compounds with 8 to 10 C-atoms. Since the total doses delivered and the quality of the radiation in terms of LET, linear energy transfer, were similar, the difference in product ratios is attributed to the different dose-rates. M.Ebert

541.15

6668. ELECTRON-BOMBARDMENT-INDUCED DISSOCIATION OF ALKALINE EARTH OXIDES. P.Wargo and W.G.Shepherd.
Phys. Rev., vol. 106, No. 4, 694-703 (May 15, 1957).

The oxygen evolution induced by electron bombardment of alkaline earth oxides has been directly observed by means of an omegatron mass spectrometer. Threshold energies for the process have been determined as 9.5 ± 0.5 eV, 14.0 ± 0.5 eV, and 16.9 ± 0.5 eV for BaO, SrO, and MgO, respectively. It is found that the efficiency of the process is in all cases proportional to the square of the current density at the target. It is suggested that a two-step electron excitation in the solid is involved. In the case of SrO the use of a radioactive isotope of strontium provided a monitor for the rele of the metal from the target. The energy dependence of the evolu tion of oxygen and strontium suggests that there are two processe one predominating at low energies and the other at higher energie An evolution of oxygen at a threshold energy of approximately 5 eV was observed for a variety of targets. The behaviour of this evolu tion suggested that a desorption process was involved.

DISPERSIONS. COLLOIDS. ADSORPTION

541.18

541.183 : 535.3

6669. CHANGES IN THE INFRA-RED SPECTRA OF MOLECULI DUE TO PHYSICAL ADSORPTION. N.Sheppard and D.J.C.Yates.
Proc. Roy. Soc. A, Vol. 238, 69-89 (Dec. 4, 1956).

Infra-red spectra of the molecules methane, ethylene, acetyler and hydrogen, physically adsorbed on porous silica glass have beer studied at measured surface coverages, θ. In all cases absorption bands were readily obtained for θ-values considerably less than unity; for methane it was possible to obtain spectra down to $\theta = 0.0$ Shifts occurred on adsorption for the absorption bands that were observed in the gas phase and in the adsorbed state. In several cases additional bands occurred in the spectra of the adsorbed mol cules which correspond to known fundamental vibration frequencies that are forbidden in the gas phase because of molecular symmetry Their appearance results directly from the distortion of the symmet of the molecules by surface forces. High resolution spectra of ad-sorbed methane and hydrogen obtained with a diffraction grating spectrometer enabled the shapes of the bands to be accurately dete mined. Although no fine-structure lines due to molecular rotation could be resolved, the overall shape of the broad and asymmetrical ν_3-band of methane could be explained by using as a theoretical model free rotation of the molecule about a single axis normal to th surface. The band shape is not consistent with a three-dimensiona free rotation about axes parallel as well as perpendicular to the surface. It could, however, alternatively be fitted by a Lorentz cur of half-width 28 cm^{-1}, corresponding to a broad vibration band witho rotational contribution, plus an extra overtone absorption band nea 3050 cm^{-1}. The shapes of the other bands of adsorbed methane and hydrogen are insensitive to the assumptions of free or highly restricted rotation on the surface. A comparison of the intensity o the absorption band due to adsorbed hydrogen with that of gaseous hydrogen in a strong electrical field (Crawford and Dagg, 1953) has enabled an estimate to be made of the electrostatic field at the sur face of the glass.

541.183 : 539.2

6670. X-RAY SPECTROGRAPH FOR THE KINETIC STUDY OF FORMATION AND STRUCTURE OF SURFACE LAYERS. J.J.Trillat.
Rev. Opt., Vol. 35, No. 10, 532-8 (Oct., 1956). In French.

Describes an X-ray diffraction camera in which the X-ray beam strikes tangentially the surface of a liquid drop. (Trillat, C.R. Acad. Sci. (Paris), Vol. 187, 168, 1928). Suggested applicatio are the study of surface layers, the formation of soaps, the action acids, etc., on metals, the oxidation of metals, the formation of amalgams, and the formation of electrolytic deposits. A.R.Stoke

541.183

6671. MOBILITY AND ADSORPTION OF HYDROGEN ON TUNGSTEN. R.Gomer, R.Wortman and R.Lundy.
J. chem. Phys., Vol. 26, No. 5, 1147-64 (May, 1957).

The surface diffusion of hydrogen on W field-emitters has bee investigated by making use of the low vapour pressure and high sticking coefficient of H_2 at liquid-helium temperature to obtain unilateral contamination. Average values of the energy of desorpt of H_2 have also been obtained. It is found that spreading occurs in three distinct phases. At very high initial coverages a moving bou ary migration occurs below 20°K, corresponding to migration of physically adsorbed H_2 on top of the chemisorbed layer, precipitat at its edge, and further migration over the newly covered region. For initial deposits corresponding to ~ 1 monolayer spreading se at ~ 180°K with a boundary moving radially outward from the clos packed 110 faces. The activation energy of this process is ~ 6 kc and corresponds to migration over the smooth (close-packed) reg of the tip followed by precipitation of chemisorbate at trap sites o the rough regions. At coverages too low to permit saturation of t diffusion out of the latter becomes rate controlling so that bounda

free diffusion with E ≅ 9.5 kcal and at even lower coverages with E ~ 16 kcal is observed. The heat of adsorption of H_2 at extremely low coverage is found to be 64 kcal, but drops rapidly with increasing coverage. These results lead to the conclusion that surface heterogeneity is largely the result of surface topography and is inherent on all but the close-packed faces of W. The activation energies for diffusion are found to be 10 to 20% of the binding energy, depending on the nature of the sites. It is also seen from the low-temperature spreading that ~ 75% of the chemisorbed layer can be formed below 20°K with effectively zero activation energy, and a large probability factor. The bearing of these results on the mechanism of some catalytic reactions is discussed. A.

CHEMICAL STRUCTURE 541.2/.6

541.57

6672. AN EXAMPLE OF CHELATION C=O...H–N DETECTED BY INFRARED SPECTROSCOPY. M.L.Josien and M.Joussot-Dubien.
Cahiers de Phys., No. 74, 22-3 (Oct., 1956). In French.

Comparison of the infrared spectrum of 1-benzoyl-phenothiazine with that of phenothiazine and of n-methyl-1-benzoyl-phenothiazine gives evidence of an intramolecular bond between neighbouring CO and NH groups. G.I.W.Llewelyn

541.6

6673. SPECTROPHOTOMETRIC STUDIES OF THE IONIZATION OF THE TRIPHENYL METHANE GROUP OF DYES. M.Gillois.
Cahiers de Phys., No. 71-72, 1-22 (July-Aug.); No. 75-76, 49-59 (Nov.-Dec., 1956). In French.

541.6 : 539.13 : 532.73

6674. IODINE COMPLEXES IN INERT SOLVENTS.
II. COMPLEXES OF IODINE WITH SOME AROMATIC ETHERS AND BIPHENYL IN CARBON TETRACHLORIDE. P.A.D. de Maine.
J. chem. Phys., Vol. 26, No. 5, 1189-91 (May, 1957).

For Pt I, see Abstr. 4539 (1956). Characteristic constants and absorption spectra are given for anisole, p-dimethoxy-benzene, o- and p-methoxy-biphenyl, and biphenyl complexes with iodine, as determined in carbon tetrachloride solution near room temperature. Three absorption maxima are found for the anisole-iodine complex: at 4900 A, 3450 A, and 2950 A. The band near 4900 A is attributed to a modified iodine transition, while the two ultraviolet bands are attributed to the formation of two isomeric charge-transfer complexes. The two nondegenerate anisole donor orbitals, with different ionization potentials, are supposed to correspond to the degenerate pair of benzene e_{1g} molecular orbitals. The ultraviolet absorption spectra found for the other iodine complexes are interpreted similarly. A method for estimating the two equilibrium constants and the two extinction curves for such complexes, having isomeric forms, is suggested. A.

541.6 : 539.13 : 532.73

6675. IODINE COMPLEXES IN INERT SOLVENTS. III. IODINE COMPLEXES WITH METHANOL, ETHANOL, OR DIETHYL ETHER IN CARBON TETRACHLORIDE. P.A.D. de Maine.
J. chem. Phys., Vol. 26, No. 5, 1192-9 (May, 1957).

Thermodynamic and spectroscopic constants, obtained by a spectrophotometric method, are reported for complexes of methanol, ethanol, and diethyl ether with iodine in carbon tetrachloride. It is shown that the heats of formation of the complexes are nearly identical with values obtained by a nonspectroscopic method. From the spectroscopic and nonspectroscopic data for solutions of methanol, ethanol, and diethyl ether with iodine or with iodine and carbon tetrachloride, it is concluded that the activity coefficients for the iodine and the alcohols are independent of their concentrations and that in these cases the alcohols do not solvate the complexes even at concentrations of nearly one hundred percent alcohol. Exact molar extinction coefficients for iodine in n-heptane and in carbon tetrachloride are given. There is a detailed discussion of errors due to the neglect of temperature effects, underlying bands, and volume changes on mixing the solvents. Evidence in support of "liquid-lattice penetration complex" theory, in which it is assumed that the stabilizing forces arise from "donor-acceptor" interaction, is also discussed. It is found that Andrews and Keefer's linear relations between ΔF and ΔH or ΔS, for the aromatic complexes of iodine, do not hold for all iodine complexes. A.

541.6 : 539.13 : 532.73

6676. IODINE COMPLEXES IN INERT SOLVENTS.
VI. SOLVATION PROCESSES IN SOLUTIONS OF OXYGENATED SOLVENTS AND IODINE, BROMINE, OR SULFUR DIOXIDE.
P.A.D. de Maine.
J. chem. Phys., Vol. 26, No. 5, 1199-204 (May, 1957).

A survey of recent literature on systems containing halogens or sulphur dioxide in aliphatic oxygenated solvents or inert solvents is given. It is shown that the classical concepts of solvation processes do not apply to these systems. It is concluded that the results are best understood with the new "liquid-lattice penetration complex" theory, if it is assumed that the stabilizing energy of the heterogeneous aggregates is provided by Mulliken's "charge-transfer" forces. A new interpretation of the term "activity coefficient" is given. These coefficients are shown to arise from the neglect of lattice factors. A.

541.66

6677. ON THE BOILING POINT AND INTERMOLECULAR FORCES. S.Popovici and M.Pop.
C.R. Acad. Sci. (Paris), Vol. 244, No. 2, 195-8 (Jan. 7, 1957). In French.

The ratio of the absolute boiling point (T_b) to the molecular weight is an empirical measure of the strength of the intermolecular forces in the compound. The plot of $(T_b)/M$ is a smooth function of M for a homologous series, $(T_b)/M$ decreasing as M increases. He and Ne are anomalous when compared with the other inert gases, so is F_2 when compared with other halogens. These discrepancies are explained in terms of the electronic structures of the molecules. G.Allen

541.67 : 538.22

6678. MAGNETOCHEMICAL SYSTEMATICS.
J.Hoarau, A.Pacault and P.Pascal.
Cahiers de Phys., No. 74, 30-4 (Oct., 1956). In French.

Describes the use of the effective atomic and group magnetic susceptibilities given in Abstr. 1296 (1952) for the calculation of the susceptibility of organic molecules, and the magnetic anisotropy of aromatic molecules relative to that of benzene. Results agree well with experiments. J.Hawgood

541.67 : 538.22

6679. PREPARATION AND MAGNETIC PROPERTIES OF SOME ORGANO-SILICON DERIVATIVES.
R.Calas, N.Duffaut, J.Joussot-Dubien and A.Pacault.
Cahiers de Phys., No. 75-76, 60-1 (Nov.-Dec., 1956). In French.

CHEMICAL ANALYSIS 543/545

545.8 : 536.2

6680. AN EXPERIMENTAL CONTRIBUTION TO THE HEAT CONDUCTION PROBLEM IN DIFFERENTIAL THERMAL ANALYSIS. O.Preining.
Acta phys. Austriaca, Vol. 10, No. 3, 242-6 (1956). In German.

545.8 : 536.2

6681. DIFFERENTIAL THERMAL ANALYSIS INVESTIGATION OF THE EXOTHERMIC REACTION OF $CaSO_4.2H_2O$.
J.A.Schedling and J.Wien.
Acta phys. Austriaca, Vol. 10, No. 3, 247-54 (1956). In German.

Results are given showing the applicability of the method to the analysis of various gipsum—anhydrite mixtures and natural samples. R.F.Barrow

545.822

6682. SPECTROGRAPHIC PROCEDURE FOR ANALYSIS OF POWDERED SAMPLES OF UNKNOWN ORIGIN.
H.E.Biber and S.Levy.
J. Opt. Soc. Amer., Vol. 47, No. 5, 381-5 (May, 1957).

A simplified dilution method is described for the analysis of powdered samples of unknown origin and composition. The sample is mixed with an equal amount of graphite powder containing the reference element, germanium. A small amount of this mixture is placed in a 1 mm deep, 1 mm diameter crater drilled in the end of a 3/16 inch graphite electrode. Apparently, the diluent is essentially provided by the electrode during arcing. This rapid approximate method has an average accuracy that is acceptable for many purposes. The method also permits the determination of the relative amounts of the elements in a very small sample (~ 1 mg). A.

545.827

6683. CHEMICAL ANALYSIS OF SURFACES BY NUCLEAR METHODS. S.Rubin, T.O.Passell and L.E.Bailey.
Analyt. Chem., Vol. 29, No. 5, 736-43 (May, 1957).

Nuclear scattering and nuclear reactions induced by high-energy protons and deuterons have been applied to the analysis of solid surfaces. The theory of the scattering method, and determinations of oxygen, aluminium, silicon, sulphur, calcium, iron, copper, silv barium, and lead by the scattering method are described. Carbon, nitrogen, oxygen, fluorine, and sodium were also determined by nuclear reactions other than scattering. The methods are applicat to the detection of all elements to a depth of several microns, with sensitivities in the range of 10^{-3} to 10^{-6} gramme per square centi- metre.

CRYSTALLOGRAPHY 548

548.0

6684. SIMPLIFIED LIGHT REFLECTION TECHNIQUE FOR ORIENTATION OF GERMANIUM AND SILICON CRYSTALS. R.D.Hancock and S.Edelman.
Rev. sci. Instrum., Vol. 27, No. 12, 1082-3 (Dec., 1956).

A collimated light beam 0.075 in. diameter from a zirconium arc falls on the etched surface of the hemispherically ground end of the semiconductor ingot placed behind a thin glass plate. The latter reflects the light beam back on to the light entrance hole in a view- ing screen perpendicular to the beam. Movement of the ingot allows focusing and location of the reflected image for symmetry. Basic patterns related to orientation are obtained and can be recognized with little difficulty. G.F.J.Garlick

548.0 : 538.652

6685. ON EVEN EFFECTS IN SINGLE CRYSTALS. G.P.D'yakov.
Vestnik Moskov. Univ., No. 5, 43-8 (1956). In Russian.

The Akulov law (Z. Phys., Vol. 52, 389, 1928) concerning the magnetostriction of a single crystal magnetized to saturation agrees well with the experiments of Honda and his collaborators. For the (111) plane divergence arises between theory and experiment due to the field there being insufficient for saturation. The present paper, which is entirely theoretical, sets out to compute the magneto- striction for the (111) plane in the region of approach to saturation. C.R.S.Manders

548.4 : 539.537

6686. INDUCTION OF RING CRACKS ON DIAMOND SURFACES. S.Tolansky and V.R.Howes.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 521-6 (May, 1957).

In extension of earlier studies on the production of percussion marks on diamond surface using a diamond sphere as indenter, it is now found that much softer materials than diamond sphere can be used to produce pressure crack figures on diamond surfaces. Tung- sten carbide and sapphire balls have produced cracking on an octa- hedral face of diamond, this face having been already shown to be the face of least resistance to this type of deformation. The cracks are of the same nature as those previously produced by a diamond indenter and the critical stress necessary is of the same order, but the cracks are on a bigger scale and have greater associated disturb- ance. The full development of a pressure crack is traced and mul- tiple beam interference pictures show the extent of the surface damage. Three distinct types of cracking are found associated with each percussion mark and the mechanism of each is discussed in terms of cleavage, crystallographic shatter and cracks due to shock- wave propagation. A.

548.5

6687. PREPARATION OF SILVER HALIDE CRYSTALS OF HIGH PURITY. N.R.Nail, F.Moser, P.E.Goddard and F.Urbach.
Rev. sci. Instrum., Vol. 28, No. 4, 275-8 (April, 1957).

For the investigation of silver halides, crystals of very high purity are required. Methods for preparing such crystals are des- cribed. They include the procedures used for the preparation of the dry precipitates, for crystal growing in controlled atmospheres, and for the preparation of specimens for the study of optical, electrical, and photochemical properties. The crystals are optically clear and have a sharp absorption edge with no detectable impurity absorption, even in samples several centimetres thick. For the silver chloride crystals, the ionic conductance was found to show the familiar break point at an unusually low temperature, and the interior of the crys- tal shows extremely little darkening even upon very strong exposure. For spectrochemical determination of the purity of the crystals, a concentration series of internal standards were prepared for seven- teen elements. For the more important impurities, the molar con- centration does not exceed 10^{-7}. A.

548.

6688. ICE-FORMING NUCLEI. B.J.Mason and J.Hallett.
Nature (London), Vol. 179, 357-9 (Feb. 16, 1957).

In continuation of earlier work tests have been made on new s stances and it has been established that minute iodine crystals act as ice-forming nuclei below -14°C and cupric sulphide below -6°C A modified form of cloud chamber has been used. The introductio of a fairly large iodine crystal into a cold mixing-cloud chamber produces numerous ice crystals in a few seconds at temperatures below -14°C. Further tests showed that aerosol particles were necessary as nuclei for the iodine crystals and acted as bases for the deposition of ice. With iodine in solution in a water drop the ice-nucleating ability is lost. Aqueous solutions of silver nitrate and sulphate and lead nitrate and chloride are not effective but wit an iodine crystal the silver salts form great numbers of ice crysta at -6°C and the lead salts below -14°C. For very pure finely gro specially prepared cupric sulphide nucleation occurs below -6°C. On supercooled films silver iodide, lead iodide and cupric sulphide form ice crystals at threshold temperatures respectively of -5°C, -6°C and -7°C, and vanadium pentoxide at -15°C. It is concluded that the initiation and growth of ice on a foreign substrate is not determined solely by the lattice geometry of the latter, but that other properties such as the strength and configuration of the surf force field and, as indicated by the experiments on iodine, the solu bility of the crystal may be important. R.S.Re

548

6689. A REMARK ON THE KYROPOULOS CRYSTAL GROWING PROCESS. I.Tarján and G.Turchányi.
Acta phys. Hungar., Vol. 6, No. 2, 339-40 (1956). In German.

Agitation of the melt during growth of alkali halide crystals b the Kyropoulos technique causes faces to appear on the crystals, the melting point isothermal no longer uniquely determines the growth boundary. Face formation on the bottom end of the crysta occurs when the temperature of the melt below the crystal is mai tained at the melting point. J.Fran

548

6690. UNUSUAL RING STRUCTURE OF VACUUM-EVAPORATE THALLIUM-DOPED SELENIUM. H.C.Gorton.
J. appl. Phys., Vol. 28, No. 2, 279-80 (Feb., 1957).

Thin films of Tl-doped Se were evaporated on to brass plates across which a temperature gradient of 32°C was maintained, the cooler end being at 75°C. Crystallization, initiated at centres in th Se matrix, spread radially, forming complex ring structures in th higher-temperature regions. J.Fra

548

6691. ON THE ORIGIN OF CERTAIN SPIRALS OF LARGE STEP-HEIGHT OBSERVED ON CRYSTAL SURFACES. A.R.Lang
J. appl. Phys., Vol. 28, No. 4, 497-8 (April, 1957).

Periodic bunching together of advancing or retreating atomic sheets frequently occurs on crystal surfaces inclined at small an with densely packed atomic planes, and it causes microscopically observable steps to appear. Around a domed surface, in the case growth, or around an etch pit, in the case of solution or evaporati such steps usually form concentric rings. It is shown, however, a simple "mistake" in the early stages of step formation will pro instead of rings, a continuous spiral step. No screw dislocations therefore, are required for the production of this spiral step.

548

6692. A NEW TYPE OF ZINC SULPHIDE CRYSTALS. A.Addamiano.
Nature (London), Vol. 179, 493-4 (March 2, 1957).

ZnS crystals sublimed in a hydrogen atmosphere formed a number of spiral loops, about 3 mm in diameter. J.Fra

548.57

6693. TERTIARY TRANSLATION OF THE BASAL PLANES OF Zn CRYSTALS. F.Blaha.
Acta phys. Austriaca, Vol. 10, No. 3, 239-41 (1956). In German.

Single crystal Zn wires 100-150 μ dia. and several cm long were grown by the Czochralski technique. The crystals were of high perfection; under tension, twinning occurred twice over a large section, followed each time by slip across the basal plane.

J.Franks

548.57

6694. PREPARATION OF MONOCRYSTALS OF BENZENE. R.Gay and B.Lemanceau.
Cahiers de Phys., No. 74, 38-40 (Oct., 1956). In French.

Describes the methods used for the preparation and testing of single crystals of suitable shape and orientation for magnetic measurements.

J.Hawgood

548.57

6695. THE SURFACE NATURE OF THE POLYCRYSTALLINE AND MONOCRYSTALLINE AgBr PLATES. K.Vacek.
Czech. J. Phys., Vol. 6, No. 4, 406 (Aug., 1956). In Russian.

Three phenomena were observed in polycrystalline specimens which, contrary to Hedges and Mitchell's method (see Abstr. 3780, 6354/1953) were not stretched: (1) a coarse macro-mosaic with blocks of 0.15-0.30 mm; (2) small crystals in the blocks are orientated along certain lines, and (3) on recrystallization, the larger of the small crystals reveal a spiral growth. Similar features of growth were found in some monocrystalline AgBr specimens, where they cannot be explained in the same way as for the polycrystalline specimens.

F.Lachman

548.57 : 539.166.08

6696. PREPARATION OF HIGH-SENSITIVITY CADMIUM SULFIDE CELLS FOR GAMMA-RAY DETECTION. L.E.Hollander, Jr.
Rev. sci. Instrum., Vol. 28, No. 5, 322-3 (May, 1957).

Single synthetic CdS crystals 3 x 4 x 10 mm, having dark conductivities from 10^{-9} to 10^{-10} ohm^{-1} cm^{-1}, were prepared for gamma-ray detection. In a 50 r/hr Co^{60} field the conductivity increased to 10^{-6} ohm^{-1} cm^{-1}. The crystals were grown in a static system at 930 ± 5°C. Indium electrodes were applied by an ultrasonic soldering technique. The effect of constant excitation from radium to reduce the crystal rise time is illustrated. The time response and spectrographic analysis of crystals and commercial CdS powder is presented.

A.

548.574 : 539.185.9

6697. ETCHING BEHAVIOR OF PILE-IRRADIATED GERMANIUM AND SILICON SINGLE CRYSTALS. R.Chang.
J. appl. Phys., Vol. 28, No. 4, 385-7 (April, 1957).

Germanium single crystals pile-irradiated at 20°C and 10^{14} to 10^{17} n/cm^2 etch differently from similar crystals which have not been irradiated. The irradiated crystals when etched with CP-4 show a finer surface granulation. This difference in etching behaviour is reduced on annealing. Kinematic studies indicate an activation energy for the annealing process between 1.6 and 1.8 eV. The etching behaviour of silicon single crystals shows a similar change on pile irradiation. The present work, though preliminary in nature, suggests a new experimental approach to the study of radiation damage.

A.

548.575 : 539.231

6698. REVEALING OF SURFACE TEXTURE BY METAL DEPOSITION. V.R.Guru Moorti and M.K.Gharpurey.
Nature (London), Vol. 179, 529 (March 9, 1957).

When Zn was vacuum evaporated onto stearic acid crystals, a heavy deposit formed on the smooth surfaces, while the growth step edges remained free and were clearly revealed.

J.Franks

ATOMIC AND X-RAY CRYSTALLOGRAPHY

548.7

548.7

6699. ON THE EVALUATION OF CHARACTERISTIC TEMPERATURES FOR CUBIC CRYSTALS. A.B.Bhatia and G.E.Tauber.
Phil. Mag., Vol. 45, 1211-13 (Nov., 1954).

A method is given for the evaluation of the integral

$$I = \int [\Sigma_i \{v_i(\theta,\phi)\}^{-3}] d\Omega$$

where v_i (i = 1,2,3) are the velocities of the three elastic waves for a given direction (θ,ϕ) of propagation and integration is over all directions.

548.7

6700. LATTICE DYNAMICS OF BODY-CENTERED AND FACE-CENTERED CUBIC METALLIC ELEMENTS. III. CUBIC INVARIANT POLYNOMIALS. J.de Launay.
J. chem. Phys., Vol. 26, No. 3, 663-7 (March, 1957).

For Pt II see Abstr. 621 (1955). When the frequencies obtained from the secular equations of lattice dynamics are expressed as power series in the magnitude of the propagation vector, the coefficients of the series terms are polynomials in the direction cosines of the vector. These polynomials are invariant under the symmetry operations of the cube. A number of their properties which have proved to be of value in computations of the lattice spectrum are presented.

A.

548.7

6701. PHONON FREE PATH IN AN ISOTOPIC MIXTURE. D.C.Mattis.
Phys. Rev., Vol. 106, No. 4, 721-2 (May 15, 1957).

A time-dependent perturbation theory is developed for the classical laws of motion of a crystal lattice. This is applied to the case of a cubic crystal which is chemically pure but contains various isotopic constituents. The random variations in the masses of neighbouring atoms scatter plane wave phonons. This can be described by a phonon mean free path, l. A formula $l = a/3.3\epsilon$ is obtained, where l = mean free path, a = lattice spacing, $\epsilon = \langle (m_n - m)/m \rangle_{rms}$; m_n being the mass of the nth atom, and m the average mass. This result is in agreement with an independent quantum-mechanical calculation which is sketched.

A.

548.7

6702. COUPLING STRENGTH FOR RESONANCE FORCE TRANSFER OF ELECTRONIC ENERGY IN VAN DER WAALS SOLIDS. W.T.Simpson and D.L.Peterson.
J. chem. Phys., Vol. 26, No. 3, 588-93 (March, 1957).

The interpretation of the absorption spectrum of a molecular crystal requires a knowledge of the strength of resonance force electrostatic interaction between molecules in the crystal as compared to an energy parameter characterizing the molecular vibrational level pattern. Depending on the relative magnitudes of these energy terms the spectrum reflects absorption by the crystal as a whole or by independent, though oriented molecules. These two familiar cases are examined from both stationary-state and time-dependent points of view with the object of defining the energy parameters. The resonance force interaction term is a theoretically derived quantity, the crystal electronic bandwidth; the comparable vibrational energy term is shown to be the width of the total electronic band comprising all the vibronic transitions for an isolated molecule. Particular attention is given to the case in which these terms are nearly equal.

A.

548.7

6703. QUANTUM STATES AND OPTICAL TRANSITIONS OF THE F_2^+-CENTRE ELECTRON. M.F.Deĭgen and V.L.Vinetskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 289-95 (1957). In Russian.

A system consisting of two negative vacancies and an electron in an ionic crystal (F_2^+-centre) is considered. The thermal dissociation and ground-state energies of the system are computed by quantum-mechanical consideration of the motion of lattice ions. The parameters of the optical absorption band — its position and half-width — have been determined. For illustration the numerical values have been obtained for KCl and KBr crystals and the results satisfactorily agree with the experimental results.

A.

548.7

6704. BEHAVIOUR OF AN ELECTRON IN A PERIODIC ELECTRIC AND UNIFORM MAGNETIC FIELD. G.E.Zil'berman.
Zh. éksper. teor. Fiz., Vol. 32, No. 2, 296-304 (1957). In Russian.

The general form of the eigenfunction of an electron in a periodic electric and uniform magnetic field is deduced. The equation of motion of an electron with an arbitrary dispersion law in a (weak) magnetic field is determined. The broadening of the discrete energy levels of the electron in a crystal in a magnetic field is considered.

A.

548.7

6705. ON THE QUANTUM THEORY OF THE MANY ELECTRON SYSTEM IN A VIBRATING LATTICE. I. H.Haken.
Z. Phys., Vol. 146, No. 5, 527-54 (1956). In German.

The electrons which move in a perfect translation lattice,

able to vibrate harmonically, are described by a Schrödinger equation with an interaction which depends on their mutual separation, velocity and spin. Because of the invariance of the Hamiltonian to translations two types of solutions are found, one of the form exp(iKR)U, the other being obtained by expansion in localized electronic wave-functions. The latter solution shows that, among other things, the collective motion of the electrons in the lattice is accompanied by a lattice configuration which retains its shape. These results are applied to the problem of semiconducting polar media linking up with the polaron theory and the exciton theory in a vibrating polar crystal. With the aid of the method of the apparent mass and under the assumption of medium strength coupling between an exciton and the lattice vibration the ground state is determined by a variational method. F.Ansbacher

548.7

6706. ON THE QUANTUM THEORY OF THE MANY ELECTRON SYSTEM IN A VIBRATING LATTICE. II. ON FRÖHLICH'S ONE-DIMENSIONAL MODEL OF A SUPERCONDUCTOR. H.Haken.
Z. Phys., Vol. 146, No. 5, 555-70 (1956). In German.

The result of Pt I (see preceding abstract) are applied to Fröhlich's model and a new solution is constructed with the correct translation properties and having lower expectation value of the energy than Fröhlich's solution. The new solution removes the objection that the current-carrying superconducting states are not orthogonal to the ground state. Fröhlich's energy gap between states of collective electron motion (superconducting states) and those of individual electron motion (normal conduction states) is retained. But as the latter states are no longer orthogonal to the ground state further investigation of the model is desirable.

F.Ansbacher

548.7

6707. ON THE STATISTICS OF SPIN WAVES. D.Frank.
Z. Phys., Vol. 146, No. 5, 615-28 (1956). In German.

The Heitler- London approximation is used for the treatment of the exchange interaction in a crystal. It is shown, contrary to present views, that the spin waves correspond to a Fermi gas with interaction, if each of the atoms contains only one electron outside a closed shell. This is proved on the one hand by deducing the statistical behaviour from the symmetry properties of the wave-function (the exact wave-function for the linear chain, which is anti-symmetric in the wave-numbers, is derived). On the other hand, the treatment of the exchange interaction with the aid of second quantization leads to the same tesult. In both proofs polar states have to be excluded. With the usual approximation spontaneous magnetization can be deduced for the plane lattice and linear chain. F.Ansbacher

548.7

6708. CALCULATION OF THE ENERGY OF THE GROUND STATE OF AN EXCITON IN A POLAR CRYSTAL BY A NEW VARIATIONAL METHOD OF FEYNMAN. I. H.Haken.
Z. Phys., Vol. 147, No. 3, 323-49 (1957). In German.

Feynman's variational principle (Abstr. 3261/1955) is related to ordinary quantum-mechanical methods and used to obtain the energy for small exciton radius. J.E.Caffyn

548.7 : 539.152.2

6709. A METHOD FOR DETERMINING THE NUCLEAR RELAXATION MECHANISM IN CRYSTALS.
E.R.Andrew and K.M.Swanson.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 436-40 (April, 1957).

Describes a method of distinguishing between magnetic dipolar and electric quadrupolar interaction mechanisms from a study of the saturation behaviour of the nuclear magnetic resonance absorption spectrum lines using only one coil around the specimen and one radio frequency. The general case in which power is supplied at the frequency of all the spectrum lines is analysed, and the saturation factors for certain special cases are obtained. The results are compared with experimental saturation curves for the Na^{23} resonance in sodium nitrate. A.E.De Barr

548.7

6710. PARAMAGNETIC RESONANCE ABSORPTION IN GADOLINIUM TRICHLORIDE.
C.A.Hutchison, Jr, B.R.Judd and D.F.D.Pope.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 514-20 (May, 1957).

The paramagnetic resonance spectrum in crystals of $GdCl_3$ diluted with $LaCl_3$ and $CeCl_3$ has been examined. The splitting of the ground level $^8S_{7/2}$ of Gd^{3+} in zero magnetic field is small, and has a remarkable temperature dependence. A theory to account for the experimental results is developed, and it is shown that perturbation mechanisms both linear and quadratic in the crystalline field potential are important. A.

548

6711. TERM SPLITTING IN AN ELECTROSTATIC CRYSTAL FIELD. E.Fick.
Z. Phys., Vol. 147, No. 3, 307-16 (1957). In German.

The degenerate energy terms, their number and multiplicity are determined by an investigation of the irreducible representatio of the 32 crystal classes. In an appendix the specific irreducible representation of the crystal double groups (Kristalldoppelgruppen) is tabulated. J.E.Caffy

548

6712. THE BEHAVIOUR OF THE PARAMAGNETIC IONS IN THI SINGLE CRYSTALS OF SOME SIMILAR SALTS OF THE IRON GROUP OF ELEMENTS. I. HYDRATED CUPRIC SALTS.
A.Bose, S.C.Mitra and S.K.Datta.
Proc. Roy. Soc. A, Vol. 239, 165-83 (Feb. 26, 1957).

The anisotropic behaviours of a series of similarly constituted salts of the Cu^{2+} ion have been compared by accurate methods of observation developed in this laboratory. It is found that the principal magnetic axes of the crystal and the relative orientation of th Cu^{2+} ion in the unit cell change in most cases, in a few cases abnormally, owing to the anisotropic thermal expansion of the lattice. The thermal magnetic anisotropy behaviour of the Cu^{2+} ion in most of the salts may be well represented in the form $K_{\parallel}-K_{\perp}=A+B/T+T^2$. Because of the degeneracy of the spin levels (except for very small spin interaction effects) in Cu^{2+} ion, C/T^2 obviously arises, in the range of temperatures used here, mainly from a temperature-dependence of the theoretical high-frequency and Curie terms. Abnormalities in the values of the A and B terms also point to the same conclusion. The predominant B term is different from salt t salt and very markedly so between the alkali double salts on the on hand and ammonium and thallium double salts on the other. The tetragonal level separation in different salts and its variation with temperature are discussed.

548

6713. MULTIPOLE ORDER OF LATTICE CELLS OF IONIC CRYSTALS. F.G.Fumi and M.P.Tosi.
Phil. Mag. (Eighth Ser.), Vol. 2, 568-9 (April, 1957).

The multipole moments of cells of various cubic symmetries are considered. A.R.Stoke

54

6714. DISLOCATIONS. [LES DISLOCATIONS]. J.Friedel.
Paris: Gauthier-Villars (1956) vi + 314 pp. [Monographies de chimie physique]. In French.

A detailed, modern review and exposition of the theoretical an experimental study of dislocations and their relation to the mecha ical properties of crystalline solids, divided into three parts: (I) properties of individual dislocations, (II) properties of assembl of dislocations, (III) effects resulting from the interaction of dislo cations with other lattice defects. Part I is introduced by the classical elasticity theory of dislocations which is used to describ their strain fields and energy, to calculate the interaction energie of dislocations with one another and with crystal surfaces and to demonstrate the "relativistic" properties of moving dislocations. Following this, effects coming from the specifically crystalline nature of the solid are discussed (e.g. force for movement of dislocations, properties of interstitial atoms and vacancies) and a de tailed discussion is given of the "climb" of dislocations and of dis location jogs in relation to the creation and annihilation of vacanci and interstitials. Stacking faults and imperfect dislocations are discussed (in particular in the face-centred cubic metals and ordered alloys with the CsCl structure) and their application to the understanding of mechanical twinning and martensitic transforma tions is fully explained. Part I ends with an account of the growth crystals containing dislocations (rates of growth and formation of growth spirals). Part II begins by describing the form of assembl of dislocations (Frank networks and polygonization structure) seen in etch patterns and by X-rays (mosaics). When crystals are strained, elements of the Frank network act as sources of new dis locations. The conditions under which these new dislocations are prevented from running out of the crystal (thus preventing perfect plasticity) are examined and the phenomena of "easy glide", defor ation bands, and work hardening in both single crystals and poly-crystals are discussed. A full account of the recovery of such col worked materials is then given with interpretation of the phenome of polygonization and recrystallization. Part II concludes with chapters on theories of creep in plastically deformed metals and the occurrence of cracks and of brittle fracture. Part III details the nature and statistical thermodynamics of the interactions be tween dislocations and impurity atoms and on this basis interpret

known impurity hardening effects - by solid solution, precipitates, Guinier zones and in particular those effects coming from the formation of impurity atmospheres around dislocations. This last topic is developed to provide an understanding of yield-point phenomena, of ageing of crystals, of micro-creep, of blue brittleness, etc. Part III concludes with an account of some other ways in which dislocations may be studied: X-ray diffraction, electrical conductivity, magnetic saturation in ferromagnetics. The book contains much detail and many references, and is well illustrated. A.B.Lidiard

548.7

6715. ON THE INTERACTION OF A DISLOCATION AND A CHARGED SOLUTE ION. R.Landauer.
Phil. Mag., Vol. 45, 1216-18 (Nov., 1954).

Shows that the general form for the interaction between a solute atom and a lattice dilatation is the same whether one uses (a) the simple misfitting atom (elastic inclusion) model or (b) a more sophisticated model which allows for the different charge on the impurity ion core and the consequent change in the number of conduction electrons. A.B.Lidiard

548.7 : 537.311.31

6716. QUENCHING VACANCIES IN ALUMINIUM. F.J.Bradshaw and S.Pearson.
Phil. Mag. (Eighth Ser.), Vol. 2, 570-1 (April, 1957).

See Abstr. 2821 (1957). From resistivity measurements on quenched specimens a vacancy-formation energy of 0.76 eV was obtained, and the rate of annealing indicated that a vacancy disappeared after $\sim 10^{10}$ "jumps". A.R.Stokes

548.7

6717. CRYSTAL VACANCY EVIDENCE FROM ELECTRON SPIN RESONANCE. J.E.Wertz and P.Auzins.
Phys. Rev., Vol. 106, No. 3, 484-8 (May 1, 1957).

Three distinct patterns have been observed in the electron spin resonance spectrum of chromium (+3) ions in single crystals of magnesium oxide. The chromium (present in naturally-occurring amounts or augmented) replaces magnesium (+2) ions substitutionally. The Cr(+3) spectrum depends upon whether compensation for the extra charge occurs in the immediate vicinity, and if so, upon the position of the compensating charge. The first pattern is a single line surrounded by a hyperfine quartet, representing that expected for a ^4F ion in a purely cubic electric field if most of its isotopes have zero nuclear spin I, and one isotope has $I = \frac{3}{2}$. This means that charge compensation cannot occur in a position as close as that of the next-nearest magnesium ion. The second pattern has nine lines (each with a hyperfine quartet), the angular dependence of which shows axial symmetry about the principal crystal axes. It is explained in terms of a vacancy in the magnesium position next-nearest the chromium ion. The third pattern arises from ions with axes of symmetry in face-diagonal ([110]-type) directions. This symmetry is ascribed to the effects of a magnesium ion vacancy in a position nearest the central ion. A.

548.7 : 539.32

6718. INTERNAL FRICTION AND DEFECT INTERACTION IN GERMANIUM: EXPERIMENTAL. J.O.Kessler.
Phys. Rev., Vol. 106, No. 4, 646-53 (May 15, 1957).

Some aspects of the interrelation of lattice defects and impurities in single crystals of germanium have been studied by means of the internal friction method. The logarithmic decrement of Ge crystals undergoing small-amplitude longitudinal forced vibrations was measured as a function of temperature, frequency, and concentration of impurities and edge dislocations. A peak in the curve of logarithmic decrement v. temperature was found at 380° C, for a frequency of 40 kc/s. From the peak shape and from the dependence of its position on the applied vibrational frequency, it was inferred that the peak is due to an anelastic relaxation phenomenon with relaxation time $\tau = \tau_0 \exp(H/RT)$, where $\tau_0 = 10^{-13\pm1}$ sec and $H = 25 \pm 3$ kcal/mole. At high temperatures the logarithmic decrement was found to rise with temperature according to the equation $\delta = \delta_0 \exp(-H'/RT)$, where $H' = 23 \pm 2$ kcal/mole. A phenomenological interpretation of these results is given in terms of a mechanism depending on the interaction of lattice vacancies with the edge components of dislocations present in the specimens. By using this interpretation, the activation energies for the generation of lattice vacancies, for their diffusion, and for self-diffusion in germanium are derived. The respective values, which are 48 ± 4, 25 ± 3, and 73 ± 5 kcal/mole, are in agreement with analogous values obtained by other observers. It is also implied that 10^{10} vacancies/cm^3 are normally frozen into Ge crystals during growth. This concentration corresponds to the equilibrium concentration in the vicinity vicinity of 550° C. A.

548.7 : 539.32

6719. INTERNAL FRICTION AND DEFECT INTERACTION IN GERMANIUM: THEORETICAL. J.O.Kessler.
Phys. Rev., Vol. 106, No. 4, 654-8 (May 15, 1957).

A model has been constructed in which small vibrations of dislocation line segments cause displacements in the point-imperfection distributions surrounding the dislocations. The energy lost through the motions of the point imperfections is observed as mechanical damping. The motion of the dislocations is obtained from the theory of Koehler. The Cottrell potential is taken as the interaction between dislocations and point defects. It is shown from the high-frequency expansion of the theoretical energy dissipation that the dependence of the dissipation on strain, frequency, and temperature is essentially the same as that of the normal anelastic relaxation effect, in agreement with the experimental observations. It is further shown that the magnitude of the effect is such as to support the hypothesis that the lattice vacancy, present in a concentration of approximately 10^{10}/cm^3, is the point defect which interacts with dislocations, giving rise to the observed vibrational energy loss. In turn, using the numbers derived from the vacancy hypothesis, it is shown that the cutoff for the purely elastic dislocation potential is several atom spacings from the dislocation line. A.

548.7

6720. ELECTRONIC PROPERTIES OF AROMATIC HYDROCARBONS. III. DIFFUSION OF EXCITONS. O.Simpson.
Proc. Roy. Soc. A, Vol. 238, 402-11 (Jan. 8, 1957).

For Pts I-II, see Abstr. 3873-4 (1956). Non-conducting excited states are known to occur in certain insulating crystals as a result of excitation in the fundamental absorption band. The excited region is called an exciton. Excitons are believed to be mobile and capable of transporting energy through a crystal. In Pt II the migration of excitons was shown to give a quantitative explanation of the observed transfer of fluorescence excitation in solid solutions of aromatic hydrocarbons. However, in common with other experimental evidence in this field, the exciton motion itself was inferred rather than observed. To demonstrate exciton migration conclusively it is necessary to measure the diffusion constant, or the diffusion length $(D\tau)^{1/2}$, where τ is the lifetime of the excited state. In this paper a method is described by which the migration of excitons across a thin specimen can be observed, and solutions of the diffusion equation with the appropriate boundary conditions are shown. The method has been applied experimentally to anthracene, and the exciton flux as a function of distance agrees with the theory. The observed diffusion length is 460 A. In an isotropic medium this would correspond to a root-mean-square displacement of 1120 A between the points of origin and decay of an exciton. Comparison with the results obtained in Pt II suggests that in anthracene, which is strongly anisotropic, the migration of excitons occurs most easily between molecules in adjacent b–c planes, i.e. normal to the laminae in the graphite-like structure. A.

548.7 : 535.42

6721. AN OPTICAL METHOD OF STUDYING THE DIFFRACTION FROM IMPERFECT CRYSTALS. I. MODULATED STRUCTURES. B.T.M.Willis.
Proc. Roy. Soc. A, Vol. 239, 184-91 (Feb. 26, 1957).

The correspondence between the X-ray diffraction pattern of a crystal and the optical diffraction pattern of a two-dimensional grating has been used to determine the nature of the diffraction from imperfect crystals. A two-dimensional grating representing the structure of the imperfect crystal is prepared on a very fine-grained photographic plate by a technique which gives an error of less than 1 μ in the positions of the elements of the grating. The grating is placed in a bath of cedar-wood oil between optically flat glass plates, and its Fraunhofer diffraction pattern is observed in a modified Lipson diffractometer. Illustrations are given of the application of the optical method to the study of the diffraction from modulated structures, such as the alloy Cu_4FeNi_3 with a periodic variation of lattice parameter, and the age-hardening aluminium–copper alloy with a variation of both lattice parameter and structure amplitude. A.

548.7 : 535.42

6722. AN OPTICAL METHOD OF STUDYING THE DIFFRACTION FROM IMPERFECT CRYSTALS. II. CRYSTALS WITH DISLOCATIONS. B.T.M.Willis.
Proc. Roy. Soc. A, Vol. 239, 192-201 (Feb. 26, 1957).

Lipson's optical diffractometer has been used to determine the diffraction patterns of gratings representing crystals with dislocations. The optical method lends itself readily to the solution of the two-dimensional problem of diffraction by a single edge dislocation.

The intensity distribution near the ideal reciprocal lattice points is, in general, complex, but for certain special points it is relatively simple and in agreement with that deduced by a new theory of Suzuki. An earlier theory of Wilson's fails to explain the observed intensity distribution. Diffuse scattering, not predicted by Suzuki's theory, occurs in the form of streaks joining the reciprocal lattice points. The diffraction has also been studied from gratings consisting of photographs of dislocated bubble rafts, and from a grating whose diffraction pattern is related to that of a screw dislocation. A brief discussion is given of the expected diffraction patterns from crystals with various arrays of dislocations. A.

548.7

6723. DIFFUSION POROSITY IN METALS AND ALLOYS. Ya.E.Geguzin.
Uspekhi fiz. Nauk., Vol. 61, No. 2, 217-47 (1957). In Russian.

In the crystalline lattice under conditions of thermodynamic equilibrium not all lattice junctions are occupied by atoms. These vacancies provide a "porosity" in the metal. The present paper surveys the state of knowledge of porosity problems, more especially the contributions to the topic made in the last five years. Among subjects dealt with are: mutual diffusion of metals forming solutions, change of volume of the diffusing specimen during the diffusion process, the vaporization of a volatile component from an alloy, single-component systems, supersaturation of crystalline lattice with vacancies, generation of diffusion pores, the sintering of mixtures of metallic powders. The paper is well illustrated with tables and photographs. 67 refs. (38 Russian). C.R.S.Manders

548.7 : 536.413

6724. MACROSCOPIC EXPANSION AND DEFECTS OF SILVER CHLORIDE. W.Zieten.
Z. Phys., Vol. 146, No. 4, 451-6 (1956). In German.

As in previous experiments on AgBr crystals (see Abstr. 6254/1956) the lattice defects in AgCl crystals are investigated by measuring the variation of thermal expansion coefficient with temperature for crystals with different contents of $CdCl_2$ as impurity. Frenkel defects appear to predominate below 400°C but near the crystal melting points the results are not clear and Schottky defects may also be present. G.F.J.Garlick

548.7

6725. RADIATION DAMAGE IN LANTHANUM MAGNESIUM NITRATE CRYSTALS CONTAINING RADIOACTIVE ISOTOPES. B.Bleaney, W.Hayes and P.M.Llewellyn.
Nature (London), Vol. 179, 140-2 (Jan. 19, 1957).

Crystals of $La_2Mg_3(NO_3)_{12}.24H_2O$ irradiated with Co^{60} γ-rays, Am^{241} α-rays and Pm^{147} β-rays all showed electron resonance spectra with three hyperfine lines due to N^{14} coupling with A 40 – 60 x 10^{-4} according to crystal direction. These are interpreted as due to NO_2 molecules formed from the NO_3^- ions. Am^{241} and Pm^{147} impurities showed no electron resonance spectra. D.H.Whiffen

548.7

6726. DENSITY OF COLOR CENTERS IN BARIUM OXIDE AS A FUNCTION OF THE VAPOR PRESSURE OF BARIUM. C.Timmer.
J. appl. Phys., Vol. 28, No. 4, 495-6 (April, 1957).

Single crystals of barium oxide were exposed at a temperature of 1423°K or 1473°K to barium vapour of different pressures ranging from 3.4 x 10^{-5} mm Hg to 7.6 x 10^{-2} mm Hg. The resulting blue coloration was measured in an absorption spectrometer, which provided estimates of the number of colour centres per cm^3, N_F. The relation between N_F and the number of barium atoms per cm^3 in the vapour, N_V, was $N_F = 1.5 \times 10^{13} N_V^{1/3}$. This relation can be tentatively explained by assuming total dissocation of the colour centres into oxygen vacancies and free electrons at the temperature of formation. A.

548.7 : 535.37

6727. LUMINESCENCE AND SYMMETRY PROPERTIES OF COLOR CENTERS. J.Lambe and W.D.Compton.
Phys. Rev., Vol. 106, No. 4, 684-93 (May 15, 1957).

A study has been made of the luminescent emission of F-, M-, and R-centres in NaCl, KCl, and LiF. When such centres are excited by polarized light, the resulting emission can be analysed for polarization. This yields information on the symmetry properties of the emitting centre. In the case of M-centres and of F-centres made at 77°K the results obtained are consistent with the models widely used for these centres. In the case of the R_1- and R_2-centres the situation is more complex and it appears that as far as optical properties are concerned some relationship exists between these centres. Excitation in either band yields the same emission band with very similar polarization properties. This has been interpreted in terms of an energy transfer process between R_1- and R_2-centres. When crystals containing F-, M-, and R-centres are investigated, the behaviour of the F-band emission is markedly changed from the case where only F-centres are present. The characteristic F-centre emission disappears and instead F-band excitation gives the emissions characteristic of either the R_1- or M-centres. Under these conditions the emission excited by polarized F-band light is polarized. Experiments were conducted to test whether these effects might be ascribable to the presence of "high" excited states of the M- and R-centres in the region of the F-band. This does not appear to be the case. It is therefore concluded that energy transfer processes can occur between the F-centre and the M- and R-centres. The observed dichroism of the F-band is ascribed to an interaction of F-centres with nearby M- and R_1-centres.

548

6728. AN EXPLANATION OF AN ANOMALOUS FORM OF SUB-BOUNDARY IN ALUMINIUM. D.E.Bradley and R.Phillips.
Proc. Phys. Soc. B, Vol. 70, Pt 5, 533-5 (May, 1957).

Dislocation patterns in Al foil observed by electron microscop (see Abstr. 2819/1957) show apparent anomalies, which are explained in terms of the observation that dislocations are not all se with the same contrast. A.R.Stoke

548.7 : 535.37 : 535.34

ABSORPTION AND LUMINESCENCE OF COLOUR CENTRES IN KCl AND NaCl. See Abstr. 5994

548.7 : 537.311.

DISLOCATIONS AND RESISTIVITY OF PbS CRYSTALS. See Abstr. 6175

548.73/.7

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548

6729. HEATING OF POWDER SPECIMENS DUE TO X-RAY IRRADIATION IN CRYSTAL ANALYSIS. H.Weyerer.
Naturwissenschaften, Vol. 43, No. 18, 419 (1956). In German.

The expected rise in temperature is calculated for a typical case of a specimen suspended by a fine glass fibre, and is found to be less than 0.01°C. A.R.Stok

548.7

6730. A METHOD FOR PHOTOMETRIC EVALUATION OF SEEMANN–BOHLIN AND GUINIER X-RAY PHOTOGRAPHS. M.Lang and A.Simon.
Naturwissenschaften, Vol. 44, No. 1, 7 (1957). In German.

The broadening of X-ray reflections due to oblique incidence X-rays on the film is eliminated by using oblique incidence in the photometer. A.R.Stok

548.

6731. X-RAY POWDER DIFFRACTION ASSEMBLY FOR STUD AT ELEVATED TEMPERATURES AND HIGH GAS PRESSURES. E.J.Goon, J.T.Mason and T.R.P.Gibb, Jr.
Rev. sci. Instrum., Vol. 28, No. 5, 342-4 (May, 1957).

An assembly has been designed to be used with a Straumanis type powder camera and a modified oscillatory attachment. The assembly consists of a small resistance furnace with a cooling sh and a specimen holder. The furnace is capable of heating the sam to a maximum temperature of 500°C and the temperature sam can be controlled to within ±1 deg. C. The specimen holder, which is constructed from beryllium and monel metal, has withst hydrogen gas pressures above 600 lb/in^2 at 500°C. The apparatu has been applied to the structural study of the system: uranium–uranium hydride–hydrogen gas. The lattice parameter of uraniu hydride (β-tungsten structure) is reported for the temperature range, 25°C to 500°C, with an accuracy of ±0.001 A.

548.

6732. DETERMINATION OF THE LAUE CLASS AND ORIENTATION OF A CRYSTAL WITHOUT FACES FROM ONE PHOTOGRAPH OF A STATIONARY CRYSTAL IN POLY-CHROMATIC RADIATION. A.I.Zaslavskiĭ and D.L.Rogachev.
Kristallografiya, Vol. 1, No. 2, 159-64 (1956). In Russian.

The method involves taking one photograph on cylindrical fil A special net diagram is given to facilitate the calculations. The resulting quantities are plotted directly on the Federov sphere, which simplifies the work and shortens the time required for a determination. R.F.S.Hear

548.735

6733. DETERMINATION OF THE SIGNS OF STRUCTURE AMPLITUDES. A.I.Kitaĭgorodskiĭ.
Kristallografiya, Vol. 1, No. 1, 14-16 (1956). In Russian.
Graphs and charts based on the author's theory enable the signs to be determined in cells containing up to 50-70 atoms.
R.F.S.Hearmon

548.735

6734. STRUCTURAL TYPES WITH CLOSE-PACKED ATOMS. POSSIBLE STRUCTURAL TYPES IN COMPOUNDS AB_3. N.L.Smirnova.
Kristallografiya, Vol. 1, No. 2, 165-70 (1956). In Russian.
Possible structural types are considered in which atoms A are surrounded by atoms B, and atoms B contain only one atom A within their coordination sphere. Application to ϵ-Cu_3Sn shows that two structural types are possible. R.F.S.Hearmon

548.735

6735. METHOD FOR THE EXACT DETERMINATION OF THE LATTICE CONSTANTS, BREADTH OF REFLECTING REGION AND X-RAY REFLECTION COEFFICIENT, USING SINGLE CRYSTALS. J.Bačkovský.
Czech. J. Phys., Vol. 6, No. 4, 390-8 (Aug., 1956). In German.
A single crystal is examined by a broad pencil of X-rays passing through a Soller slit after two-crystal monochromatization. A Geiger-Müller counter is used as a detector. The values of the lattice constants are determined with respect to a standard crystal. A discussion of the errors of the method is given. J.Thewlis

548.735

6736. DETERMINATION OF THE STATIC DEFECTS OF CRYSTAL LATTICE USING X-RAY RADIATION OF DIFFERENT WAVELENGTH. V.A.Il'ina and V.K.Kritskaya.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 5, 765-8 (1956). In Russian.
In previous papers (Il'ina, Kritskaya and Kurdyumov, Dokl. Akad. Nauk SSSR, Vol. 85, No. 4, 773, 1952; ibid., No. 5, 997, 1952· Kritskaya, Kurdyumov and Nodia, Zh. tekh. Fiz., Vol. 25, No. 2, 177, 1955) the authors found that the value of the defects in the crystal lattice of iron deformed while cold, and of the static defects of solid solution in the martensite crystals, when obtained from X-ray reflections in Co radiation was greater than in the case of Mo radiation, the difference exceeding the experimental error. This finding was also borne out by Kochanovska (Abstr. 5101/1955). The authors conducted an investigation on deformed α-Fe and on the α solid solution of Fe with 0.8% Nb, using the following X-rays: Mo, Co, Fe and Cr. The defects determined were the lattice defects of the third kind and the static defects of the solid solution. It was found that the straight lines expressing the dependence of the logarithm of α_1/α_2 on the order of reflection, when obtained with Mo radiation had a much smaller gradient than those obtained with Co, Fe or Cr radiation, these three gradients being almost identical. Hence the values of static defects obtained with the Cr, Fe or Co radiations are almost identical, while those obtained with Mo radiation are much (up to 33%) smaller. In order to find out whether this difference also exists in the case of dynamic defects (thermal vibrations of the atoms), X-ray photographs were taken of Al and Ag, at room and liquid nitrogen temperatures, using Co and Mo radiations. It was found that the values of the mean-square amplitudes of thermal vibrations and of the characteristic temperature are independent of the wavelength of X-ray radiation. F.Lachman

548.735

6737. IS "SUPER-REFINEMENT" LEGITIMATE IN X-RAY CRYSTAL ANALYSIS? A.I.Kitajgorodskij (Kitaĭgorodskiĭ).
Nature (London), Vol. 179, 410-11 (Feb. 23, 1957).
In the author's view, the errors in the correction of observed intensities for absorption and extinction render "super-refinement" (i.e. additional refinement by the use of anisotropic atomic scattering factors, etc.) of very doubtful value. A.R.Stokes

548.735

6738. IS "SUPER-REFINEMENT" LEGITIMATE IN X-RAY CRYSTAL ANALYSIS?
K.Lonsdale, R.Mason and J.Grenville-Wells; E.G.Cox and D.W.J.Cruickshank.
Nature (London), Vol. 179, 856-9 (April 27, 1957).
Kitajgorodskij's contention (see preceding abstract) to the contrary is disputed on the grounds (a) that the accuracy of intensity measurements can in fact be high enough to warrant the use of "super-refinement", and this is borne out by the fact that the final reliability index is found to be larger than the probable error in the intensity data; (b) that the data on atomic vibrations obtained by "super-refinement" of structures are in agreement with those obtained by other means, such as infrared spectroscopy.
A.R.Stokes

548.735

6739. THE FOLD POLYMONIAL AND THE LATTICE FACTOR FOR A PARACRYSTALLINE LATTICE.
R.Hosemann, R.Bonart and G.Schoknecht.
Z. Phys., Vol. 146, No. 5, 588-614 (1956). In German.
A theory is worked out for the diffraction of X-rays by a paracrystal in which there is correlation between neighbouring cells. It gives nearly the same results as previous theories for the sharp peaks of intensity in the reciprocal space, and also for regions of very diffuse scattering. The theory is compared with the optical diffraction pattern of a two-dimensional grating representing a paracrystal, and good agreement is obtained. A.R.Stokes

548.736

6740. STANDARD X-RAY DIFFRACTION POWDER PATTERNS. V. DATA FOR 45 INORGANIC SUBSTANCES. H.E.Swanson, N.T.Gilfrich and G.M.Ugrinic.
Circ. Nat. Bur. Stand., No. 539 (Vol. 5), 77 pp. (1955).
For Pt IV see Abstr. 5106/1955.

548.736

6741. STANDARD X-RAY DIFFRACTION POWDER PATTERNS. VI. DATA FOR 44 INORGANIC SUBSTANCES. H.E.Swanson, N.T.Gilfrich and M.I.Cook.
Circ. Nat. Bur. Stand., No. 539 (Vol. 6), 62 pp. (1956).

548.736.1 : 539.893

6742. X-RAY INVESTIGATIONS OF THE STRUCTURE OF MATTER AT PRESSURES UP TO 30 000 ATMOSPHERES. L.F.Vereshchagin and I.V.Brandt.
Dokl. Akad. Nauk SSSR, Vol. 108, No. 3, 423-4 (1956). In Russian.
Describes a specially designed camera for taking the Debye X-ray photographs at high pressures. The substances were confined in a beryllium cone surrounded by a steel cone with a slit, the pressure being transmitted by means of lithium. X-ray photographs of Bi at atmospheric pressure and at 30 000 atm show that the sudden volume decrease which takes place between these two pressures should be related to a change in crystal structure, and not to electron transitions. F.Lachman

548.736.3

6743. BORON ARRANGEMENT IN A B_9 HYDRIDE.
R.E.Dickerson, P.J.Wheatley, P.A.Howell, W.N.Lipscomb and R.Schaeffer.
J. chem. Phys., Vol. 25, No. 3, 606-7 (Sept., 1956).
The unit cell has a = 11.80, b = 6.94, c = 11.25 A, $\beta = 109^\circ 9'$, and the boron atoms form an icosohedral net. A.R.Stokes

548.736.3

6744. CUBIC FORM OF BORON NITRIDE. R.H.Wentorf, Jr.
J. chem. Phys., Vol. 26, No. 4, 956 (April, 1957).
Specimens of the cubic form were prepared from the hexagonal form by heating to around 1800°C at pressures around 85 000 atm. It has the zinc-blende structure, with a = 3.615 A; it is hard enough to scratch diamond, and is scratched by diamond. A.R.Stokes

548.736.3 : 538.222

6745. THE $TiFe_2O_5$–Ti_2FeO_5 SOLID SOLUTION SERIES.
S.Akimoto, T.Nagata and T.Katsura.
Nature (London), Vol. 179, 37-8 (Jan. 5, 1957).
Reports the existence of an orthorhombic solid solution connecting $Fe_2O_3.TiO_2$ and $2TiO_2.FeO$ in the FeO–Fe_2O_3–TiO_2 ternary system. The crystal structure is very much like that of pseudobrookite ($TiO_2.Fe_2O_3$). The specimens examined were paramagnetic and magnetic susceptibilities and lattice parameters are given.
A.E.De Barr

548.736.3 : 537.312.5

CRYSTAL STRUCTURE OF CAESIUM ANTIMONIDE. See Abstr. 6187

548.736.4

6746. THE CRYSTAL STRUCTURE OF POTASSIUM HYDROXIDE MONOHYDRATE. J.Clastre.
Cahiers de Phys., No. 74, 24-5 (Oct., 1956). In French.
Thin plates of $KOH.H_2O$ were examined in a de Jong retigraph using Mo radiation. The unit cell is monoclinic, space group $P2_{1/c} - C_{2h}^5$, a = 5.80 A, b = 5.83 A, c = 7.88 A, $\beta = 109^\circ 50'$. Z = 4 molecules, measured density $\rho = 1.92$, calculated density $\rho_X = 1.96$. Atomic parameters, temperature factors and interatomic distances are given. J.Adam

548.736.4

6747. LOCALIZATION OF HYDROGEN IN THE CRYSTAL STRUCTURE OF LITHIUM HYDROXIDE MONOHYDRATE. H.Rabaud and R.Gay.
Cahiers de Phys., No. 74, 26-8 (Oct., 1956). In French.

548.736.4

6748. TRANSFORMATION OF CALCITE TO ARAGONITE BY GRINDING. J.H.Burns and M.A.Bredig.
J. chem. Phys., Vol. 25, No. 6, 1281 (Dec., 1956).

Calcite was ground for periods up to 38 hr, and X-ray diffraction records showed that varying proportions of aragonite had been formed. Possible mechanisms of a change to this less stable form are briefly considered. A.R.Stokes

548.737 : 539.133

6749. STRUCTURE OF THE TRICLINIC FORM OF PARA-DICHLOROBENZENE. J.Housty and J.Clastre.
Cahiers de Phys., No. 74, 28-30 (Oct., 1956). In French.

X-ray diffraction measurements (on crystals in the metastable state) lead to the conclusion that the molecular hexagon is not regular, the Cl atoms tending to "crush" it, and the two C—Cl bonds not being collinear. J.Hawgood

548.74

6750. DETERMINATION OF THE ORIENTATION OF CRYSTALS IN ELONGATED PARTICLES. R.B.Campbell.
J. appl. Phys., Vol. 28, No. 3, 381-2 (March, 1957).

A method is given of determining orientations from diffraction photographs taken in an electron microscope; this has been applied to samples of γ-Fe_2O_3. A.R.Stokes

548.74 : 538.222

6751. ELECTRON DIFFRACTION INVESTIGATION AND MAGNETIC MEASUREMENTS ON NICKEL (II) BISACETYL-ACETONE. S.Shibata, M.Kishita and M.Kubo.
Nature (London), Vol. 179, 320-1 (Feb. 9, 1957).

The measurements show that the molecule is coplanar having four oxygen atoms at the corners of a square, and values for the angles and distances involved are given. Susceptibility and X-ray measurements are also reported. E.P.Wohlfarth

548.74

6752. OBSERVATIONS ON 18/8 CHROME NICKEL-STEEL POINTS IN THE FIELD EMISSION MICROSCOPE. F.Stangler.
Z. Phys., Vol. 146, No. 4, 496-504 (1956). In German.

An apparatus for the controlled electrolytic etching of 18/8 chrome nickel-steel wire, to form very fine points, is described. The patterns formed in the field emission microscope are reproducible, and are interpreted in terms of the crystal structure of the point. The influence of the point temperature and presence of oxygen are also studied. A.E.I. Research Laboratory

548.74

6753. KINEMATIC THEORY OF THE INTENSITY OF REFLECTIONS IN ELECTRONOGRAMS. I. POINT ELECTRONOGRAMS. B.K.Vaĭnshteĭn.
Kristallografiya, Vol. 1, No. 1, 17-26 (1956). In Russian.

Scattering of electrons by ideal crystals is considered first, and the treatment is extended to the more usual case of specimens with mosaic structure. Formulae are derived for the scattering by thin mosaic layers, and the effect of increasing the thickness of the layers is discussed. R.F.S.Hearmo

548.74

6754. KINEMATIC THEORY OF THE INTENSITIES OF REFLECTIONS IN ELECTRONOGRAMS. II. ELECTRONOGRAMS FROM TEXTURES AND POLYCRYSTALS. B.K.Vaĭnshteĭn.
Kristallografiya, Vol. 1, No. 2, 150-8 (1956). In Russian.

The intensity is expressed in terms of the distribution of the individual crystallite axes around the axis of texture.
R.F.S.Hearmo

548.7

6755. ELECTRONOGRAPHIC INVESTIGATION OF THE DEGRE OF PERFECTION OF SINGLE GERMANIUM CRYSTALS. S.A.Semiletov and Z.G.Pinsker.
Kristallografiya, Vol. 1, No. 2, 209-13 (1956). In Russian.

The possibility of applying the method to the surface layers of monocrystals is discussed. Six electronograms obtained with polis ed and etched germanium single crystals are reproduced. R.F.S.Hearmo

548.74 : 539.2

6756. ELECTRON-IMAGE RECORDING BY XEROGRAPHY. P.B.Sewell.
Nature (London), Vol. 179, 773-4 (April 13, 1957).

The letter describes the use of xerographic plates in an electron diffraction camera. The exposure times are comparable with those for photographic plates and offer the advantages of reduced gassing in vacuo and rapid processing. It is claimed that better resolution and good contrast is obtained. M.E.Hain

548.7

6757. THE ELECTRON MICROSCOPY OF PROTEIN CRYSTALS L.W.Labaw and R.W.G.Wyckoff.
Proc. K. Ned. Akad. Wetensch. B, Vol. 59, No. 2, 171-3 (1956).

A number of protein crystals have been re-examined by the electron microscope using improved replica techniques. The examination has also been extended to protein crystals of smaller size. Wherever the data are sufficiently decisive it has been found that th molecular arrangement is cubic close-packed. It is expected that the new techniques will pave the way to a better understanding of th mechanism of crystal growth. J.Thewli

548.74 : 537.5

ELECTRON DIFFRACTION BETWEEN 0.5 AND 1 MeV.
See Abstr. 6235

548.

6758. INFRARED SPECTROGRAPHY AND STRUCTURE OF CRYSTALS. A.M.Vergnoux.
Cahiers de Phys., No. 77, 40-8 (Jan., 1957). In French.

A general dissertation. G.I.W.Llewely

GEOPHYSICS 55

550.311

6759. ORIGIN OF THE EARTH'S CRUST. J.T.Wilson.
Nature (London), Vol. 179, 228-30 (Feb. 2, 1957).

"The volume and composition of the atmosphere, of the hydrosphere, and of the whole solid crust above the Mohorovičić discontinuity therefore appear to be compatible with the theory that they have been formed by volcanic extrusion during the earth's history". After evidence supporting this contention, the positions of the sites of the principal ourflows of lava are discussed, together with the probable way in which lavas are converted into rocks of continental type. A.H.Cook

550.342

6760. SEISMOLOGICAL AND RELATED ASPECTS OF THE 1954 HYDROGEN BOMB EXPLOSIONS.
T.N.Burke-Gaffney and K.E.Bullen.
Austral. J. Phys., Vol. 10, No. 1, 130-6 (March, 1957).

Seismic data, recorded in the regular way, from four American hydrogen bomb explosions of 1954, indicate that the origin-times o the explosions were, in G.M.T.: (i) Feb. 28 days 18 hr 45 min 0 se (ii) Mar. 26 days 18 hr 30 min 0 sec, (iii) Apr. 25 days 18 hr 10 m 0 sec, (iv) May 4 days 18 hr 10 min 0 sec. If these surmised time are correct, and if the assumed source-point is correct, the result show that the seismic travel-times from Bikini in all azimuths nee reductions of the order of 1-2 sec (possibly more) from the standa travel-times. The analysis focuses attention on the great value atomic explosions can have in advancing knowledge of the earth's interior when precise details or origin-times and source-points are released. The analysis is also applied to observations by Yamamoto of air waves from the explosions. It is shown that ther is no seasonal effect on the mean air velocities as suggested by Yamamoto. Also discrepancies which appeared in Yamamoto's wo between the velocities for these shocks on the one hand, and the Krakatoa eruption of 1883 and the fall of the Siberian meteor of 1908 on the other hand, are removed.

550.378 : 551.594.14

6761. WHERE IS THE EARTH'S RADIOGENIC HELIUM? M.A.Cook.
Nature (London), Vol. 179, 213 (Jan. 26, 1957)

The rate of production of He^4 from the earth's crust into the atmosphere appears to be in excess of the calculated steady-state loss due to escape through the exosphere. M.A.Grace

550.38 : 538.31

ORIGIN OF NON-DIPOLE GEOMAGNETIC FIELD. See Abstr. 6361

551.4 : 519.272 : 518.5

6762. AUTOCORRELATION OF THE EARTH'S CRUST WITH ANALOG COMPUTERS. N.D.Diamantides and M.Horowitz.
Rev. sci. Instrum., Vol. 28, No. 5, 353-60 (May, 1957).

Land-form geometry of the earth's ground surface, expressed statistically, finds application in both the civil and military phases of geology and engineering. To obtain statistics about the slope of the earth's crust, autocorrelation methods have been employed. Analogue computers were used to compute the autocorrelation functions of terrain profile heights. Each profile was read out by a standard curve follower, the output was sampled by a commutator, and the autocorrelation values were registered in a bank of capacitors. This process required approximately 10 min per profile. For two sample profiles considered — one near Akron, Ohio and the other near Phoenix, Arizona — the mean values of the terrain heights were 1200 and 1570 ft, respectively; and the r.m.s. relief values were 71 and 263 ft, respectively. A.

ATMOSPHERE. METEOROLOGY 551.5

551.510.3 : 533.12.08 : 525.3

6763. DETERMINATION OF AIR DENSITY AT HIGH ALTITUDE BY MEANS OF AN EARTH SATELLITE. G.Leitmann.
Amer. J. Phys., Vol. 25, No. 2, 115 (Feb., 1957).

It is shown that measurement of the angular momentum of an earth satellite moving in a near circular orbit may be used to determine a mean value of air density ρ_{av} at high altitude, from the derived expression: $\rho_{av} = -[2m \ln(h_1/h_0)]/[SC_D(S_1 - S_0)]$, where m = mass of satellite, $h = r^2\dot{\theta}$ = angular momentum (where subscripts 0 and 1 denote conditions at the beginning and end of the observation period), S = body cross-section, C_D = drag coefficient, and $S_1 - S_0$ = = distance covered along orbit. H.H.Hodgson

551.510.535

6764. A STUDY OF "SPREAD-F" IONOSPHERIC ECHOES AT NIGHT AT BRISBANE. III. FREQUENCY SPREADING. D.G.Singleton.
Austral. J. Phys., Vol. 10, No. 1, 60-76 (March, 1957).

For Pt II see Abstr. 7081 (1956). Virtual range versus frequency (P'f) records of the ionosphere made at Brisbane (lat. 27.5°S, long. 152.9°E) during 1952 and 1953 have been examined. It is found that occasionally neither the o- nor the x-mode of propagation penetrates the F_2-layer at a unique frequency, the upward sweeping traces either being blurred out over a range of penetration frequencies (diffuseness) or possessing a fine structure (penetration-frequency multiplicity). Temporal analysis of the occurrence of these effects reveals that they occur only at night; penetration-frequency multiplicity appearing more frequently in the hours before dawn, while the diurnal distribution of diffuseness has a maximum between 0100 and 0100 hr in summer and represents a more even distribution between 2100 and 0500 hr in winter. The seasonal distribution has a pronounced peak in the winter months and minima in the equinoctial months. These data are compared with the world-wide picture of these variations as it has emerged from the recent literature The observations are interpreted in terms of scattering from the clouds of enhanced ionization near the F_2-layer maximum which are believed to be responsible for the scintillation of radio stars. It is suggested that there is a seasonal vertical movement of these clouds, the extent of which increases with latitude. A.

551.510.535

6765. DOUBLE-LAYER PHENOMENA IN THE E_s REGION. J.A.Thomas.
Austral. J. Phys., Vol. 9, No. 4, 574-7 (Dec., 1956).

P'f and P't (2.28 Mc/s) records at Brisbane often show in the late afternoon and early evening, especially in summer, the simultaneous appearance of two types of Es ionization. These types occur at different virtual heights, and multiple-hop reflections from them often cause a "stack" of echoes. Some stacks are attributed to the horizontal movement of these layers, where one is assumed to be substantially flat and the other to have regions of small slope. G.M.Brown

551.510.535

6766. GEOGRAPHICAL DISTRIBUTION OF THE ANOMALOUS ABSORPTION OF RADIOWAVES BY IONOSPHERE IN HIGH LATITUDES. A.P.Nikol'skiĭ.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 4, 628-31 (1957). In Russian.

The author showed (Izvestiya Akademii Nauk SSSR, Seriya Geograficheskaya i Geofizicheskaya, No. 5, 15, 1954; Dokl. Akad. Nauk SSSR, Vol. 109, No. 5, 939, 1956), that the (world time) isochronals of moments when the maximum of the morning-time magnetic disturbances appears form a system of spirals originating from the pole of the homogeneous magnetization of the Earth. The author introduces a correction into Agy's results (Abstr. 9414/1954), assuming that the time of the maximum frequency of absorptions corresponds with that of the maximum on the curve of the diurnal distribution of absorption probability; this results in differences up to three hours between Agy's and corrected values. The corrected values agreed well with those read off the spirals referred to above, the differences being usually ≤ 0.5 hours and rising to 2-3 hours only for localities within the region of maximum magnetic disturbances. Results of Cox and Davies (Abstr. 2040/1955) and Agy, and the author's conclusions point to the existence, at higher latitudes, of a second (less intense than the first) zone of maximum intensity and frequency of the magnetic disturbances and polar lights, which was foreseen theoretically by Alfven (Abstr. 7548/1956). F.Lachman

551.510.535

6767. ON THE DETERMINATION OF ELECTRON DENSITY DISTRIBUTION IN THE IONOSPHERIC REGIONS FROM H'—F RECORDS. A.K.Saha.
Indian J. Phys., Vol. 30, No. 9, 464-79 (Sept., 1956).

Comparative studies have been made of the various available methods for the determination of the height distribution of electrons in the ionospheric layers. It is concluded that,for routine ionospheric work, Ratcliffe's method is the quickest though, under restricted conditions, some of the other methods yield more accurate results. Methods which take into account the effect of earth's magnetic field have also been studied. It was, however, found that the errors due to the neglect of the magnetic field are of the same order as the limits of observational errors in height measurement. The complications involved in including the magnetic field are, therefore, not warranted. This is particularly because the inclusion of the magnetic field affects only the thickness of the layer and not its height of maximum ionization, and the M.U.F. is mainly controlled by the latter. A.

551.510.535 : 621.396.821

6768. ATMOSPHERICS AND THEIR APPLICATION TO THE INVESTIGATION OF THE LOWER IONOSPHERE. K.Revellio.
Mitt. Max Planck-Inst. Phys. Stratosphäre, No. 8, 54 pp. (1956). In German.

A general survey of the problem, with practical illustrations of the various ways in which the characteristics of atmospherics can furnish information concerning the condition of the lower part of the ionosphere. From the waveform of atmospherics, affected by multiple reflections from ionosphere and earth, the height of the reflecting layer and the distance of the source of the atmospherics may be estimated. The decrease of amplitude of the pulse with the number of reflections serves as a starting point for determining reflection coefficients and electron densities. A theoretical basis for the approximate calculation of these quantities is presented. The multiplicity of the waveforms displayed by atmospherics makes any explanation of them difficult, though all can be referred to the reflection type. The dependence of the number of atmospherics observed with particular equipment on the tuning frequency used is discussed and also the dependence on time of day and season of year. Phenomena at sunset can be explained by comparison with transmitter field-strength measurements; they bear some relation to the ultraviolet absorbing region of the upper margin of the ozone layer. The increase of the number of atmospherics observed at four European stations during the solar eclipse of June 30, 1954 establishes a corresponding decrease of the attenuation in the lower ionosphere. 46 references. A.Wilkinson

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.511 : 536.253

CONVECTION FROM THE EARTH'S SURFACE. See Abstr. 6106

551.521.3 : 535.34.07

6769. RATIO-RECORDING SYSTEM FOR THE JOHNS HOPKINS 100-FOOT ABSORPTION CELL. C.H.Palmer, Jr.
J. Opt. Soc. Amer., Vol. 47, No. 5, 367-77 (May, 1957).

The instrumentation associated with this cell has been completely redesigned in order to make direct ratio-recording with good accuracy and improved resolution possible in the near (1 μ-25 μ) and intermediate (25 μ-50 μ) infrared spectral regions. In this new system the sample beam flux F_S transmitted through the absorption cell is automatically compared with the flux F_T in a by-passed reference beam and the instrumental comparison response, suitably corrected, is recorded as percent transmission. The new instrumentation includes a Czerny–Turner type grating spectrometer with which it is possible to record successive long path transmission spectra agreeing to about 2% and having a resolution of about 4 cm^{-1} at 30 microns. A.

551.521.3

6770. LIGHT SCATTERING IN THE ATMOSPHERE AND THE POLARIZATION OF SKY LIGHT. Z.Sekera.
J. Opt. Soc. Amer., Vol. 47, No. 6, 484-90 (June, 1957).

The characteristic properties of scattered light in the atmosphere can be derived from the equations of radiative transfer, conveniently formulated in terms of four Stokes polarization parameters. For the case of Rayleigh scattering, by a method outlined by Chandrasekhar, it is possible to obtain an exact solution of this equation in the sense that the effect of all orders of scattering is included. With the use of this method, the intensity and the polarization of the diffuse sky radiation in a pure, molecular atmosphere were computed. These theoretical values are compared with the results of measurements of sky-light polarization, performed by means of a new photoelectric polarimeter specially constructed for such measurements. The deviations of the observed sky-light polarization from that of a molecular atmosphere are discussed with respect to the degree of atmospheric turbidity. These deviations show a systematic character which can be deduced already from the form of the equation of radiative transfer for a turbid atmosphere. The method of solving the problem of radiative transfer for a turbid atmosphere is outlined, with emphasis on the possible determination of the type of scattering from the measurements of sky-light polarization. A.

551.521.3

6771. TRANSMISSION BY HAZE AND FOG IN THE SPECTRAL REGION 0.35 TO 10 MICRONS.
A.Arnulf, J.Bricard, E.Curé and C.Véret.
J. Opt. Soc. Amer., Vol. 47, No. 6, 491-8 (June, 1957).

Two independent methods were used: direct spectrophotometry through the transparent windows of the atmospheric gases, and measurement of the number and diameter of the water droplets, followed by a Mie-theory calculation of the spectral transmittance. Results from the two methods are in good agreement when the media are sufficiently homogeneous, as for a quiet haze or fog and artificial smoke. The following kinds of atmospheres were considered: hazes (optical density per km in the visible spectrum is less than 2); a small number of small-drop fogs (optical density per km less than 10); evolving fogs (which have changing distributions of drop-diameters); nonevolving, slightly selective fogs; artificial smokes. In addition, some information is given on the statistical distribution of drop-diameters. It was found that the transmission of haze increased markedly with increasing wavelength, from the visible to 10 microns, but this marked increase was not found for fogs. A.

551.521.3

6772. IMAGE TRANSMISSION BY THE TROPOSPHERE I.
S.Q.Duntley, A.R.Boileau and R.W.Preisendorfer.
J. Opt. Soc. Amer., Vol. 47, No. 6, 499-506 (June, 1957).

Quantitative treatment of the apparent luminance of distant objects and the reduction of apparent contrast along inclined paths of sight through real atmospheres has been accomplished by means of optical data taken from an aircraft in flight. Sample data from a single flight are used to illustrate some of the principles involved. Correlation has been found between the humidity profile to the atmosphere and its optical properties. A.

551.521.3

6773. A PHOTOELECTRIC APPARATUS FOR MEASURING THE TRANSPARENCY OF AIR. O.I.Popov.
Svetotekhnika, 1957, No. 1, 20-2. In Russian.

In order to re-calibrate an apparatus of this kind (cf. Foitzik, Wissenschaftliche Annalen, 2, 1953; Douglas, Electronics, Aug., 1947) it is necessary to wait for the recurrence of very good visibility conditions. This inconvenience can be avoided if one measures the brightness of a large luminous surface from two distances, l_1 and l_2, thus obtaining the transparency of air for the base l_2-l_1. An apparatus to effect such measurements is illustrated and described, l_1 being usually of the order of magnitude of 1, while l_2 of 100 m. Results of measurements with this apparatus were found to agree well with those obtained from the nephelometric determinations of polar curves. It is concluded that the apparatus is suitable for measuring the transparency of air in the visible spectrum for visibilities from 0.5-1 to 20-30 km, when the base of measurement is 0.4-0.5 km. F.Lachman

551.521.63

6774. ON THE USE OF A COPPER SULPHATE, COBALT SULPHATE FILTER TO OBTAIN ULTRAVIOLET IN HIGH CONCENTRATION. F.Juston-Coumat.
C.R. Acad. Sci. (Paris), Vol. 244, No. 1, 59-62 (Jan. 2, 1957). In French.

An aqueous solution in a silica cell is used to remove most of the visible from solar radiation reflected from a concave mirror of 90 cm diameter. The solution is cooled by circulation through a refrigerator. G.F.Lothian

551.574.1 : 532.65

THEORY OF THE LARGE-DISTANCE INTERACTION BETWEEN EVAPORATING OR GROWING DROPS. See Abstr. 5915

551.577.1

6775. THERMODYNAMICS OF CAPILLARY SYSTEMS IN THE ATMOSPHERE. L.Dufour.
Publ. Inst. Roy. Météorol. Belgique B, No. 20, 28 pp. (1956). In French.

Rigorous thermodynamical formulae are established for a saline drop suspended in the atmosphere for displacements in the equilibrium state and for adiabatic transformations. From the theoretical point of view this makes apparent on the one side the already known role of lateral chemical potential, that of enthalpy and of specific lateral entropy. From the practical point of view these rigorous formulae are not directly useful because there is no actual knowledge of certain superficial functions. The formulae can however be used by employing certain empirical facts, i.e. certain approximations. Generally these are introduced at the beginning for simplification but this is considered to be dangerous and leads sometimes to incorrect formulae. R.S.Read

551.593.11

6776. ON THE OBSERVATION AND PHOTOGRAPHY OF MIRAGES. E.Reeger.
Acta phys. Austriaca, Vol. 10, No. 3, 206-20 (1956). In German.

Using the generalized Snell's law for the propagation of light in an inhomogeneous medium, the path of rays is calculated for an atmosphere with a vertical temperature gradient. The model used is a diffusely reflecting surface, above which the refractive index increases linearly with height up to a certain height, and then becomes constant. The path of rays inclined very slightly to the horizontal is parabolic. The calculation predicts the occurrence of inverted and erect reflections of distant objects, and also typical distortions of mirages. A number of photographs are given of mirages over land and sea, illustrating the points predicted by the theory. B.T.M.Willis

551.594.13 : 537.565

6777. INFLUENCE OF LIGHT ON THE MOBILITY SPECTRUM OF ATMOSPHERIC IONS. G.Ortner.
Acta phys. Austriaca, Vol. 10, No. 3, 175-80 (1956). In German.

Using a coaxial condenser system in conjunction with a Comptor electrometer, the concentration of atmospheric ions within the mobility range (500 to 1.3) x 10^{-4} cm^2/volt sec was found to be large when illuminated by daylight or tungsten lamp. Outside this range, the reverse is the case. This is ascribed to change in size of the ion with a corresponding change in mobility. Similar observations are reported by J.Kunz and G.Stetter on the dependence of CO_2 concentration in air with illumination. A.E.D.Heyler

551.594.14 : 539.1

6778. CURRENT RESEARCH FINDINGS ON RADIOACTIVE FALLOUT. W.F.Libby.
Proc. Nat. Acad. Sci. U.S.A., Vol. 42, No. 12, 945-62 (Dec., 1956).

Chiefly concerned with the two long-life high-yield fission products radioactive strontium (Sr^{90}) and caesium (Cs^{137}). Fallout is classified as local, tropospheric and stratospheric. Local fallou

occurs almost immediately, tropospheric within a few months and is distributed in a band round the earth at the same latitude; stratospheric is world wide and the average time for fallout is 10 years. Explosions of less than one megaton produce practically no stratospheric fallout. Figures are given for the radiostrontium contents of soils, milks and human and animal bones for various parts of the world. It is concluded that from weapons fired to date the radiostrontium content of bone will not exceed 1% of the maximum permissible concentration. Variations of stratospheric fallout with rainfall are discussed. J.M.Hough

551.594.21 : 621.317.792 : 621.396.91

6779. MEASUREMENT OF THE INTENSITY OF THE ELECTRIC FIELD IN THUNDERCLOUDS BY MEANS OF A RADIOSONDE. V.I.Arabadzhi.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 85-8 (1956). In Russian.

From the results of radio sounding, shown in a graphical form, it is seen that the region between the 0°-10°C isotherms appears to be the separation region for oppositely charged clouds. The greatest electric field intensity registered was 200 V/cm. Z.F.Voyner

551.594.221

6780. LEADER STROKE CURRENT IN A LIGHTNING DISCHARGE ACCORDING TO THE STREAMER THEORY. S.R.Khastgir.
Phys. Rev., Vol. 106, No. 4, 616-17 (May 15, 1957).

In an earlier paper (Abstr. 6642/1954), Loeb calculated the current and fields down the axis of a streamer in a lightning discharge in relation to the streamer tip velocity and arrived at the concept of the expanding streamer channel to account for the observed breadth of the stepped leaders. Using illustrative data, Loeb calculated the value of the current from the velocity of the streamer tip and arrived at a current of about 1200 A. In doing this, Loeb had tacitly ascribed the observed field-changes during the leader to the bright leader step. It is shown here that the field-change observed cannot be ascribed to the fast step-flash but is caused by the slowly advancing pilot leader. The pilot-leader current can be calculated from Loeb's formula: $i = qv_t$, where q is the electrical charge carried by the pilot leader per cm and v_t the tip velocity of the streamer. If one assumes that 4 C of charge reach the earth during the leader stroke, the length of the channel being taken as 5 km and taking $v_t = 4 \times 10^7$ cm/sec, the pilot-leader current would be 320 A. The step-flash carries a much larger current, but since its duration is very small, the charge that flows during the step-flash is too feeble to produce observable stepped electrostatic field-changes during the stepped-leader process. A.

551.594.52

6781. THE AURORA IN MIDDLE AND LOW LATITUDES. S.Chapman.
Nature (London), Vol. 179, 7-11 (Jan. 5, 1957).

Reference is made to historical records of aurorae which show the relation of their frequency to the geomagnetic pole, and the lines of maximum frequency. They are rarely observed between 45° N and 45° S geomagnetic. World maps illustrate these facts. Data are given of some of the record aurorae and their relation to sunspots, solar flares and magnetic storms. A list is given of the most intense magnetic storms at Greenwich with suggestions that search should be made in all possible sources for evidence of the aurora having been seen. An outline is given of the programme during the International Geophysical Year to obtain full details of aurorae including their height, location in the atmosphere and form and changes of intensity. World-wide observation is aimed at by land, sea and air and especially in tropical areas. Special warnings are to be issued by the World Prediction and Warning Centre at Ft. Belvoir, near Washington. R.S.Read

BIOLOGY 57/59

578.084 : 535.321

6782. REFRACTOMETRY AND INTERFEROMETRY OF LIVING CELLS. R.Barer.
J. Opt. Soc. Amer., Vol. 47, No. 6, 545-56 (June, 1957).

The development of phase contrast and interference microscopy has focused attention on the possibility of measuring the refractive indexes of living cells. Difficulties are encountered in applying immersion methods of refractometry to living cells because the choice of immersion media is very limited. These difficulties have now been overcome by the use of protein solutions. When the refractive index of the immersion medium matches that of the cell cytoplasm the latter becomes virtually invisible and phase contrast can be used as a sensitive null indicator to determine the match position. The refractive index is directly related to the concentration of cell solids and refractometry has been extensively used for measuring such concentration in a variety of living cells. The concentration of water also follows immediately. Examples of the application of this method to retinal rods and cones, to the study of cell populations such as red blood cells, and to the investigation of the osmotic reactions of living cells are given. Other applications such as contrast variation in living cells, demonstration of chromosomes, and the spectrophotometry of clarified cell suspensions are briefly discussed. Interference microscopy can be used for the direct measurement of optical path difference and it is shown that this quantity is directly related to the dry mass per unit area. By combining interference microscopy and immersion refractometry it becomes possible to measure the cell thickness and hence to calculate dry mass and wet mass, volume, and water content of living cells. Examples of these methods are given and some of the limitations indicated. A.

578.088.5

6783. GEL DOSIMETER FOR DEPTH-DOSE MEASUREMENTS. H.L.Andrews, R.E.Murphy and E.J.LeBrun.
Rev. sci. Instrum., Vol. 28, No. 5, 329-32 (May, 1957).

A chloral hydrate-agar gel has been used for depth-dose measurements with X-rays and electrons. HCl is formed from the chloral hydrate by the radiation and thus changes pH and electrical conductivity of the gel. Radiation beams can be visualized by adding an acid-base indicator. Quantitative measurements are made by spectrophotometry or by probing the gel with a pH electrode or a conductivity electrode pair. Spatial resolution of perhaps 0.2 mm has been obtained with conductivity electrodes. Doses of 2000 rad or more are required to obtain satisfactory records, the lower limit being set by inhomogeneities in the unexposed gel. A.

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

61

612.371

6784. PURKINJE SHIFT AND RETINAL NOISE. H.B.Barlow.
Nature (London), Vol. 179, 255-6 (Feb. 2, 1957).

In a given spectral range, shortening of the wavelength of maximum absorption leads to increased sensitivity because of the relative decrease of thermal noise. Consequently, photopigments absorbing light of longer wavelengths than does visual purple "are likely to be much less stable, and this may be the cause of the lower sensitivity of the cones which contain them". [There is evidence that the sensitivity of single cones is not appreciably smaller than that of rods: this result is at variance with one of the most important quantitative predictions stemming from this theory]. R.A.Weale

612.843

6785. FURTHER STUDIES OF VISUAL MECHANISMS BY THE TWO-COLOUR THRESHOLD METHOD. W.S.Stiles.
Coloquio sobre problemas opticos de la vision, Madrid (1953), Volume I, 65-103.

The use of a high-pressure mercury-vapour source of light has made it possible to extend the author's earlier work and to show that five mechanisms operate in the fovea under the conditions of the experiment. The effect of the macular pigment is revealed by extrafoveal studies. Linear functions of the spectral sensitivities of the mechanisms π_1, π_4 and π_5 are in fair agreement with the corresponding modified C.I.E. distribution coefficients. The five mechanisms are not equivalent (one of them being due to a "limiting conditioning effect"), but the hypothesis that the differential threshold is governed by the mechanism with the lowest increment threshold in a given spectral region is supported by the data. R.A.Weale

612.843 : 535.43

6786. SCATTERING OF LIGHT BY THE RETINA.
G.Toraldo di Francia and L.Ronchi.
Coloquio sobre problemas opticos de la vision, Madrid (1953), Volume II, 138-42.

Measurements of scattered light (λs = 545, 625 mμ) in enucleated human and pig eyes suggest the existence of two scattering components: the grating effect of the retina and a directional effect due to each receptor. R.A.Weale

612.843.2

6787. THE APPEARANCE OF INTERFERENCE FRINGES FORMED DIRECTLY ON THE RETINA.
A.Fiorentini and G.Toraldo di Francia.
Coloquio sobre problemas opticos de la vision, Madrid (1953) Volume II, 72-6. In French.

The lack of additivity of luminance of interfering radiations in retinal patterns is explicable in terms of the Stiles–Crawford effect. R.A.Weale

612.843.31

6788. ENTOPTIC COLOR-PERCEPTIONS OF THE MACULAR PIGMENT BY OBSERVERS OF NORMAL AND COLOR-DEFECTIVE VISION ACCORDING TO A THREE-COMPONENTS THEORY.
D.B.Judd.
Coloquio sobre problemas opticos de la vision, Madrid (1953) Volume II, 197-217.

It is shown that Walls and Mathews' observations on Maxwell's spot can be explained by assuming the existence of a yellow macular pigment in normal and protanopic subjects. The results on deuteranopes cannot be explained on this basis. R.A.Weale

612.843.31

6789. PHYSICAL MEASUREMENT OF CONE PIGMENT IN THE LIVING HUMAN EYE. W.A.H.Rushton.
Nature (London), Vol. 179, 571-3 (March 16, 1957).

An account is given of spectral photosensitivity measurements performed on the living human fovea. Its maximum value of 4×10^{-16} cm^2 is 4.5 times as great as the photosensitivity of visual purple solutions. The actual cone pigment density is of the same order as that of visual purple in situ. R.A.Weale

612.843.37

6790. FACTORS THAT INFLUENCE THE RESOLUTION OF VISUAL DETAIL DURING DARK-ADAPTATION. C.H.Graham.
Coloquio sobre problemas opticos de la vision, Madrid (1953) Volume II, 46-55.

Visual acuity is shown to depend on the time of dark-adaptation, the luminance of the test-field, and the duration and luminance level of the pre-adapting luminance. The variables produce effects expected on the basis of orthodox theory. R.A.Weale

612.843.51

6791. THE ARCHIMEDES SPIRAL. H.C.Holland.
Nature (London), Vol. 179, 432-3 (Feb. 23, 1957).

A preliminary account of some experiments done on this effect (after-sensation of movement which follows visual stimulation by a rotating spiral) and the variables which have been employed. R.A.Weale

612.843.51

6792. A PRELIMINARY ANALYSIS OF THE STROBOSCOPIC PATTERNS. J.R.Smythies.
Nature (London), Vol. 179, 523-4 (March 9, 1957).

A description and discussion of the patterns "seen" when large retinal areas are stimulated by a large, uniform, intermittent test-field. R.A.Weale

612.843.611

6793. MEASUREMENT OF THE LIGHT ADAPTATION OF THE RODS. S.W.Smith and F.L.Dimmick.
J. Opt. Soc. Amer., Vol. 47, No. 5, 391-3 (May, 1957).

A repetition and extension of Thomson's (1949) study of the influence of "light history" on the course of dark adaptation has confirmed the finding that a longer time is required to reach stable light adaptation than some writers have stated. The differences in scotopic sensitivity following two conditions of initial adaptation persisted until 15 or 20 min of a second light stimulus had intervened. The course of adaptation to the intervening light can be traced in terms of the time in dark required to reach a given level of sensitivity. A.

612.843.613

6794. ON THE FUNCTIONAL RELATION BETWEEN LUMINOUS ENERGY, TARGET SIZE, AND DURATION FOR FOVEAL STIMULI. G.F.Nolan.
J. Opt. Soc. Amer., Vol. 47, No. 5, 394-7 (May, 1957).

The data of Graham and Bartlett, Karn and Austin have been analysed in terms of luminous energy rather than luminance. Based upon the forms of the resulting curves the hypothesis that the energy requirements are determined by aberrations is advanced. Within the limits of the Bunsen–Roscoe law the retinal energy density is a constant and beyond this critical duration the retinal illuminance is a constant. Some further uses of these relations are indicated. A.

612.843.63

6795. EXTRAFOVEAL VISION AND ITS UTILIZATION IN OPTICAL INSTRUMENTS. A.Arnulf, O.Dupuy and F.Flamant.
Coloquio sobre problemas opticos de la vision, Madrid (1953), Volume II, 19-34. In French.

Hecht's formula relating visual acuity and retinal illumination is found to be obeyed at retinal eccentricities e of 10 and 20°. The acuity is found to be inversely proportional to the contrast. The magnification is calculated which gives optimum viewing conditions for a given instrument aperture, and given object luminance and contrast. Results given for a luminance level L of 8.1×10^{-7} stilb show the optimum pupil diameter to be 0.07 cm for e = 20°, but 0.2 cm for 10°. At 10° and for all contrast levels, an exit pupil at least as large as the natural pupil (0.8 cm) is to be used when $L < 4 \times 10^{-8}$ stilb, and at 20° for $L < 4 \times 10^{-9}$ stilb. R.A.Weale

612.844.23

6796. EXPERIMENTAL ARRANGEMENT FOR THE INVESTIGATION OF CHROMATIC ABERRATION IN THE HUMAN EYE.
K.Mütze.
Optik, Vol. 14, No. 3, 97-102 (March, 1957). In German.

The chromatic aberration of the eye was measured in three observers, special care being taken to reduce the effects of accommodation and spherical aberration. The results agree well with Ivanoff's and Pinegin's, but poorly with Wald and Griffin's data. R.A.Weale

612.858

6797. SIMPLIFIED MODEL TO DEMONSTRATE THE ENERGY FLOW AND FORMATION OF TRAVELING WAVES SIMILAR TO THOSE FOUND IN THE COCHLEA. C.von Békésy.
Proc. Nat. Acad. Sci. U.S.A., Vol. 42, No. 12, 930-44 (Dec., 1956).

The model consisted of 48 pendulums whose coupling could be varied. Two examples are given to show how the simplified concept of wave motion breaks down when there is a continuous change in the medium, as in the basilar membrane, whose stiffness varies by 100 : 1, and width by 10 : 1. If there is coupling between adjacent sections of the membrane, contrary to Helmholtz' conception, travelling waves will occur, and any obstruction would change the nature of the waves, a fact of pathological importance. Waves existed on the model by reason of phase differences between the pendulums, and a change of frequency of the driving rod supporting the pendulums was transformed into a change of the place of maximum amplitude. Shorter pendulums received energy from the driving rod, but long ones received energy from neighbouring pendulums by coupling. The energy still flowed from the short pendulums (corresponding to the stiff parts of the membrane) to the long pendulums (soft parts) even when the driving force was greater on the long pendulums. Cancellation of the waves at some frequencies may explain the abrupt changes in threshold which have been previously attributed to the middle ear. The wave motions were observed by the naked eye, and are illustrated by means of photographs. D.J.Hall

612.858.71

6798. COMPARISON OF THRESHOLD OF HEARING FOR BANDS OF NOISE AND FOR PURE TONES.
J.Wentworth-Jessop and P.Vigoureux.
Nature (London), Vol. 179, 374-5 (Feb. 16, 1957).

27 subjects took part in a free-field method of threshold determination for tones at 1200 c/s and 2000 c/s, and for bands of noise centred at these frequencies. Using published figures for critical bandwidths, the ratios of the noise to tone thresholds obtained experimentally are much larger than a resonance theory of hearing would predict. D.J.Hall

LIST OF JOURNALS

The following list supplements the List of Journals published with the June number of Volume 60 (1957). Reprints of this List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

A.E.G. Progress
AEG Progress — Allgemeine Elektrizitäts-Gesellschaft, Hohenzollerndamm 150, Berlin-Grünewald. [English translations of selected articles from the AEG Mitteilungen].

"J.Stefan" Inst. Rep.
"J.Stefan" Institute, Reports — P.O.B. 199, Ljubljana, Yugoslavia.

Przeglad Telekom.
Przeglad Telekomunikacjny — Mickiewicza 18, Warsaw.

Rohde und Schwarz Mitt.
Rohde und Schwarz Mitteilungen — Tassiloplatz 7, Munich 9.

Sci. J. Roy. Coll. Sci.
Scientific Journal of the Royal College of Science — Imperial College Union, South Kensington, London, S.W.7.

Siemens Rev.
Siemens Review — Siemens-Schuckertwerke AG, Hauptwerbeabteilung "Siemens Review", Werner-von-Siemens-Strasse 50, Erlangen. [Published quarterly. English translations of selected articles from the monthly Siemens Zeitschrift].

Vestnik Moskov. Univ.
Vestnik Moskovskogo Universiteta. Seriya Fiziko-Matematicheskikh i Estestvennyh Nauk — Moscow State University, Lenin Hills, Moscow.

NEW JOURNALS

Ann. Acad. Sci. Fennicae VI
Annales Academiae Scientiarum Fennicae. VI: Physica — Snellmaninkatu 9-11, Helsinki.
No. 1 dated 1957. [Beginning with No. 35, the Series I: Mathematica-Physica is divided into two Series, of which Series I: Mathematica, continues the old numbering, while Series VI: Physica, in which articles in the field of Physics, Astronomy and Meteorology will be published, begins a new numbering].

Teleteknik (English Edition)
Teleteknik (English Edition) — 9 Valkendorfsgade, Copenhagen K.
One or two numbers annually. Vol. 1, No. 1 dated 1957. [English translations of selected articles from the Danish Edition, and occasional articles not appearing in the Danish Edition].

CHANGES OF ADDRESS

Amer. J. Phys.
J. Acoust. Soc. Amer.
J. appl. Phys.
J. chem. Phys.
J. Opt. Soc. Amer.
Noise Control
Phys. Rev.
Physics Today
Rev. sci. Instrum.
Rev. mod. Phys.
Soviet Physics JETP

For the above Journals published by the American Institute of Physics, the address now is: 335 East 45th Street, New York 17, N.Y.

Acustica — Beginning with No. 1, 1957, this journal and its Supplement, Akustische Beihefte, are published by S. Hirzel, Stuttgart-N.

Scientia Electrica — Now published by Vorstand des Institutes für hohere Elektrotechnik an der Eidg. Techn. Hochschule, Zürich.

ERRATA

Abstr. 8686 (1956) line 8 : for "Zns(Cu)" read "ZnS(Cu)".
Abstr. 738 (1957) line 3 : for "Rep. No. R/M 18" read "Mem. No. R/M 18".
Abstr. 1062 (1957) line 3 : for "(1956)" read "(1955)".
Abstr. 2224 (1957) line 2 : for "O.D.Elpat'ebskaya" read "O.D.Elpat'evskaya".
Abstr. 2832 (1957) line 2 : for "J.Alder" read "B.J.Alder".
Abstr. 2855 (1957) line 10 : should read "$T = 0.773 + 0.750d + 0.463d^2 - 0.1148d^3 + 0.00708d^4$".
Abstr. 4066 (1957) line 2 : for "I.Liebermann" read "L.Liebermann".
Abstr. 4086 (1957) line 17 : for "1051" read "1951".
Abstr. 4393 (1957) line 6 : for "past" read "part".
Abstr. 4398 (1957) line 14 : for "Maxwellian temperature" read "Maxwellian distribution".
Abstr. 4751 (1957) line 7 : for "the folded in" read "then folded in".
Abstr. 4858 (1957) line 2 : for "P.I.Garber" read "R.I.Garber".
Abstr. 4906 (1957) line 10 : for "Hg Te" read "HgTe".
Abstr. 4908 (1957) line 5 : for "Ch_3I" read "CH_3I".
Abstr. 4924 (1957) line 19 : for "post-tetatnic" read "post-tetanic".
Abstr. 5260 (1957) line 6 : for "valves" read "values".
Abstr. 5270 (1957) line 3 : for "S.Jaffray" read "J.Jaffray".
Abstr. 5489 (1957) line 8 : for "ration" read "ratio".

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